DAIRY PRODUCTION

LEVEL-III

Learning Guide -63

Unit of Competence: - Implement dairy farm waste management

Module Title: - Implementing dairy farm waste management

LG Code: AGR DRP3M17LO01-LG63

TTLM Code: AGR DRP3TTLM1219 -v1

LO1: Prepare to work with dairy waste disposal equipment

Information sheet	Learning Guide #63

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Interpreting work to be undertaken from the work program
- Identifying OHS hazards, assessing risks and implementing suitable controls.
- Selecting, using and maintaining suitable (PPE)
- Selecting, checking, and maintaining tools and equipment

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- interpreted Work to be undertakenfrom the work program, and confirmed with management.
- heled Discussions with other workers who may be affected by the maintenance activities to ensure continued smooth operation of the production process.
- identify OHS hazards are identified, risks assessed and suitable controls implemented.
- select, use and maintain Suitable Personal Protective Equipment (PPE)
- select, check, and maintain Tools and equipment suitable for the work to be undertaken

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1 and proceed other turn by turn”

5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1 and do the same on other self-check of information sheet).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to previous Learning Activity.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information sheet-1	Interpreting work to be undertaken from the work program

All livestock farms have a system for managing waste—some are elaborate, others simple and others virtually nonexistent—but all farms have some way of removing waste from animal housing/ farm and placing it where it is useful. A system, by definition, is a set of **interdependent components** working together to perform **a task**. The components are interdependent because you cannot change one part of the system without affecting the other parts. We deal with systems every day. An automobile is a mechanical system. Its task is to get you where you need to go. The transmission is a component (or a subsystem) of the automobile system. The engine will still run without the transmission, but the car will not move. The manure handling system, like the automobile, also is a set of interdependent components or parts.

1.1. The Waste Management System's Task

The animal waste management system's task is to satisfy three "clients."

I. **The Environment**: The waste handling system prevents the farm from contaminating air, soil and water.

II. **The Public**: A well-managed system keeps neighbors from complaining about odor, noise and appearance of the farm.

III. **The Producer**: The waste management system makes the farmer's job easier, not more difficult. Figure 1 shows the relationship among the three "clients." The double-headed arrows illustrate that the clients influence the system and the system influences the clients. For example, the system can impact the environment and the environment can impact the system. Temperature, rainfall, sunlight and wind all affect how the system operates. Manure handling has the potential to deliver organic matter.

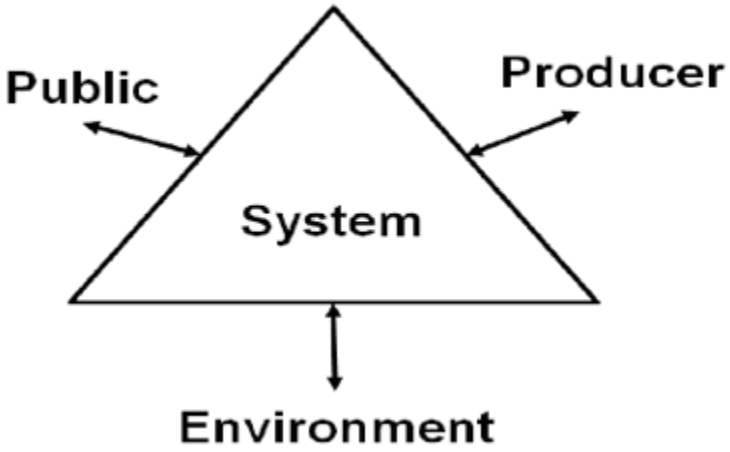


Figure 1: three clients of a waste management system

1.2. How a Waste Management System

1.2.1. Performs Its Task

Figure 2 is a general schematic diagram of a manure handling system. The boxes represent components where actions take place. The arrows represent **Transport Operations** linking the components. Transport operations move material from one place to another. Notice, as in Figure 1, the transport arrows are double-headed. This means material can flow in both directions. Rain falling on a manure storage pond fills the pond. The overflowing pond pollutes the environment.

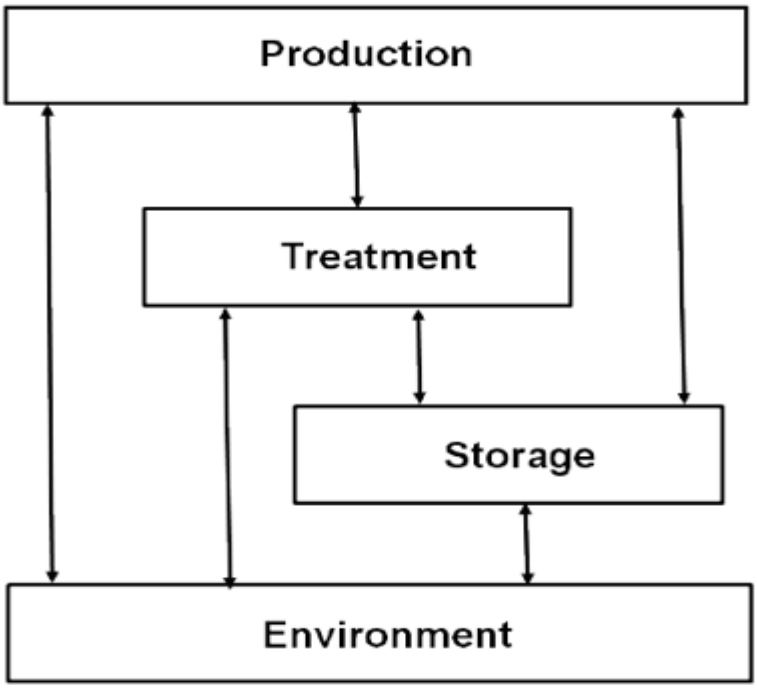


Figure 2: animal waste management system schematic

1.3. Create a Waste Management Plan

Dairy cattle produce a lot of waste if managed and used properly it can be a great resource on the farm. Manure management will be tied closely to your cropping and feeding program. If you are able to use a double cropping system on your farm it will not only allow you to produce more feed but will also allow you to apply more manure to your land. Alternatives to direct land application of manure include composting and anaerobic digestion of manure, while these options may provide additional revenue and other benefits to your dairy, they will also increase the capital investment required to get your dairy started. Every farm will need a manure management plan, but depending on the size of your farm a nutrient management plan may also be required. Check with your county Conservation District or local Extension office for more information.

Dairy Farmer Salary

A dairy farmer's salary can vary depending on the location and size of the farm. The average pay here is for farmers, ranchers, and other agricultural managers. For example, (The U.S. Bureau of Labor Statistics doesn't break out dairy farmers specifically.)

- **Median Annual Salary:** $69,620
- **Top 10% Annual Salary:** $135,900
- **Bottom 10% Annual Salary:** $35,560

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are three client's satisfaction come after better waste managements(4 points)?
2. What are two condition that make different dairy farm salaries (4 points)?

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

1. _____
   _____
2. _____
   _____

Information sheet-2	Identifying OHS hazards, assessing risks and

	implementing suitable controls.

Definition - What does Occupational Health and Safety (OHS) mean?

Occupational health and safety (OHS) relate to health, safety, and welfare issues in the workplace. OHS includes the laws, standards, and programs that are aimed at making the workplace better for workers, along with co-workers, family members, customers, and other stakeholders. Improving a company's occupational health and safety standards ensures good business, a better brand image, and higher employee morale.

2.1. How to find hazards

2.1. Inspect the Workplace

Regularly walking around the workplace and observing how things are done can help you predict what could or might go wrong. Look at how people actually work, how plant and equipment is used, what chemicals are around and what they are used for, what safe or unsafe work practices exist as well as the general state of housekeeping.

Things to look out for include the following:

- Does the work environment enable workers to carry out work without risks to health and safety (for example, space for unobstructed movement, adequate ventilation, lighting)?
- How suitable are the tools and equipment for the task and how well are they maintained?
- Have any changes occurred in the workplace which may affect health and safety?

Hazards are not always obvious. Some hazards can affect health over a long period of time or may result in stress (such as bullying) or fatigue (such as shiftwork). Also think about hazards that you may bring into your workplace as new, used or hired goods (for example, worn insulation on a hired welding set).

As you walk around, you may spot straightforward problems and action should be taken on these immediately, for example cleaning up a spill. If you find a situation where there is immediate or significant danger to people, move those persons to a safer location first and attend to the hazard urgently.

Make a list of all the hazards you can find, including the ones you know are already being dealt with, to ensure that nothing is missed. You may use a checklist designed to suit your workplace to help you find and make a note of hazards.

2.1.1. Consult Your Workers

Ask your workers about any health and safety problems they have encountered in doing their work and any near misses or incidents that have not been reported. Worker surveys may also be undertaken to obtain information about matters such as workplace bullying, as well as muscular aches and pains that can signal potential hazards.

2.1.2. Review Available Information

Information and advice about hazard and risk relevant to particular industries and types of work is available from regulators, industry associations, unions, technical specialists and safety consultants.

Manufacturers and suppliers can also provide information about hazards and safety precautions for specific substances (safety data sheets), plant or processes (instruction manuals). Analyses your records of health monitoring, workplace incidents, near misses, worker complaints, sick leave and the results of any inspections and investigations to identify hazards. If someone has been hurt doing a particular task, then a hazard exists that could hurt someone else. These incidents need to be investigated to find the hazard that caused the injury or illness.

2.2. How to do a risk assessment

All hazards have the potential to cause different types and severities of harm, ranging from minor discomfort to a serious injury or death. For example, heavy liquefied petroleum gas (LPG) cylinders can cause muscular strain when they are handled

manually. However, if the cylinder is damaged causing gas to leak which is then ignited, a fire could result in serious burns. If that leak occurs in a store room or similar enclosed space, it could result in an explosion that could destroy the building and kill or injure anyone nearby. Each of the outcomes involves a different type of harm with a range of severities, and each has a different likelihood of occurrence.

2.2.1. Work Out How Severe the Harm Could Be

To estimate the severity of harm that could result from each hazard you should consider the following questions:

- What type of harm could occur (e.g. muscular strain, fatigue, burns, laceration)?
- How severe is the harm?
- Could the hazard cause death, serious injuries, illnessor only minor injuries be requiring first aid?
- What factors could influence the severity of harm that occurs?
- How many people are exposed to the hazard and how many could be harmed in and outside your workplace?
- Could one failure lead to other failures?
- Could a small event escalate to a much larger event with more serious consequences?

2.2.2. Work Out How Hazards May Cause Harm

In most cases, incidents occur as a result of a chain of events and a failure of one or more links in that chain. If one or more of the events can be stopped or changed, the risk may be eliminated or reduced.One way of working out the chain of events is to determine the starting point where things begin to go wrong and then consider:

- ‘If this happens, what may happen next?’ This will provide a list of events that sooner or later cause harm.

In thinking about how each hazard may cause harm, you should consider: the effectiveness of existing control measures and whether they control all types of harm,how work is actually done, rather than relying on written manuals and procedures

infrequent or abnormal situations, as well as how things are normally meant to occur.Consider maintenance and cleaning, as well as breakdowns of equipment and failures of health and safety controls.

2.3. How to develop and implement control options

Information about suitable controls for many common hazards and risks can be obtained from: codes of practice and guidance materialmanufacturers and suppliers of plant, substances and equipment used in your workplace industry associations and unions. In some cases, published information will provide guidance on the whole work process. In other cases, the guidance may relate to individual items of plant or how to safely use specific substances. You may use the recommended control options if they suit your situation and eliminate or minimize the risk.

2.4. Developing Specific Control Measures

You may need to develop specific control measures if the available information is not relevant to the hazards and risks or circumstances at your workplace. This can be done by referring to the chain of events that were recorded during the riskassessment.

For each of the events in the sequence, ask: “What can be done to stop or change the event occurring?” Working through the events in the sequence will give your ideas about all possible ways to eliminate or minimize the risk. There may be more than one solution for each of the events.

The control option you choose should be: one that provides the highest level of protection for people and is the most reliable – that is, controls located towards the top of the hierarchy in Figure 3. available – that is, it can be purchased, made to suit or be put in place. suitable for the circumstance in your workplace – that is, it will work properly given the workplace conditions, work process and your workers

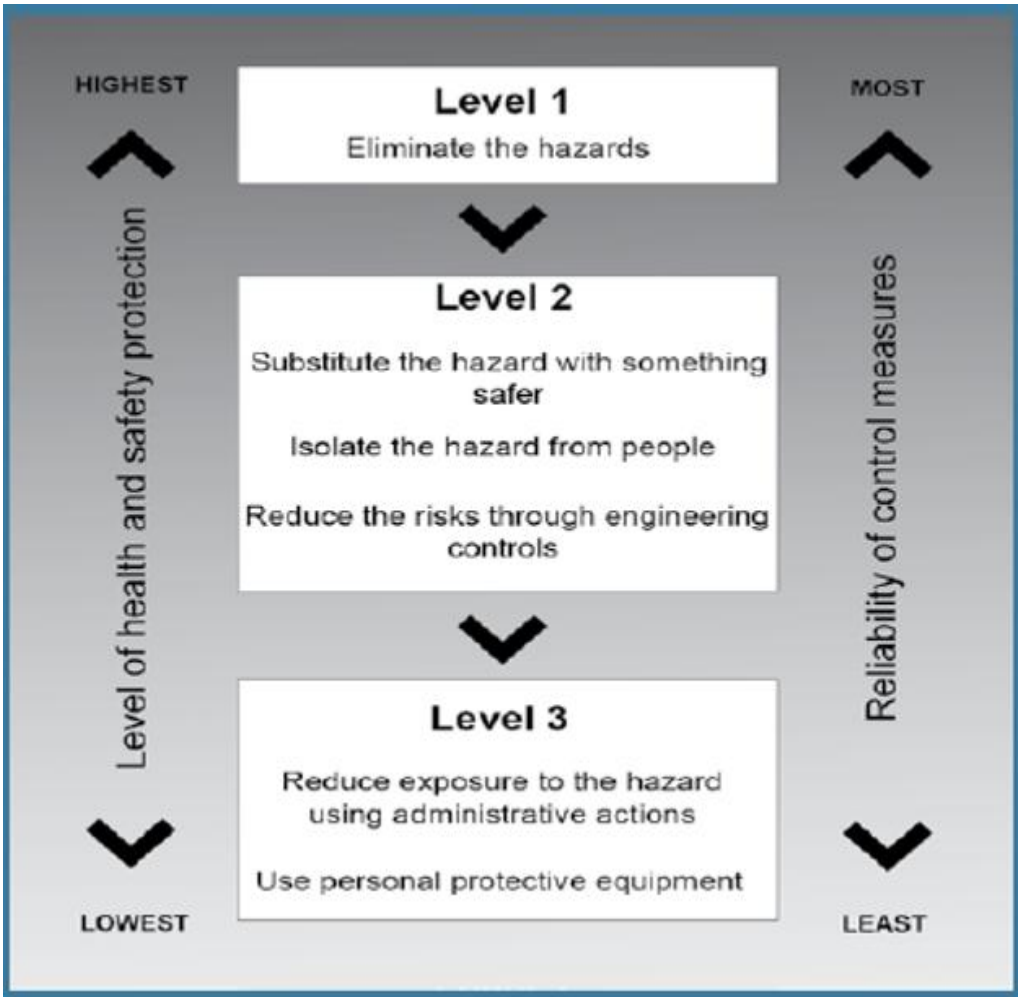


Figure 3: the hierarchy of risk controls

2.5. Hazards and correspondingcontrol points

Hazards Control points

Hazard	**Control points**
biohazard	
Transmission of pathogens and contaminants	• Animal housing and population density • Disease diagnosis (horizontal and vertical transmission) • Health and hygiene of visitors and personnel • Vehicles/clothing/instruments/equipment • Infected/contaminated carcasses, tissues or secretions • Bedding management • Insect or pest vectors

Waterborne infections and infestations	• Water quality • Effluent management • Watering equipment
Transmission of pathogens and contaminants	Transmission of pathogens and contaminants • Animal housing and population density • Disease diagnosis (horizontal and verticaltransmission) • Health and hygiene of visitors and personnel • Vehicles/clothing/instruments/equipment • Infected/contaminated carcasses, tissues or secretions • Bedding management • Insect or pest vectors
Chemical hazards	
Toxins of biological origin (plants, fungi, algae)	• Feed, pasture and water quality • Farm location • Animal movements • Feed production, storage and transport
Radionuclide pollution	• Farm location • Sources of feeds and water
Chemical contamination of environment, feed and water	• Farm location • Animal movement • Use of agricultural chemicals • Feed and water quality • Equipment and building materials • Hygiene practices
Physical hazards	
Injuries	• Farm location • Infrastructure • Population density • Animal handling • Construction and equipment

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is OHS (4 points)?
2. Write major methods that used to find hazard (4 points)?
3. What are the common hazards (4 points)?

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

1. _____
   _____
2. _____
   _____
3. _____
   _____

Information sheet-3	Selecting, using and maintaining suitable (PPE)

PPE refers to any specialized equipment or clothing worn by farmers and ranchers for protectionagainst health and safety hazards. PPE is designed to protect many parts of the body; eyes, head, face, hands, feet, ears, or torso. PPE does not prevent accidents, but it does prevent or reduce injury and even fatalities when used.

3.1. Why is PPE important?

Making the workplace safe includes providing instructions, procedures, training and supervision to encourage people to work safely and responsibly.Even where farmer controls and safe systems of work have been applied, some hazards might remain. These include injuries to:

- the lungs, eg from breathing in contaminated air
- the head and feet, eg from falling materials
- the eyes, eg from flying particles or splashes of corrosive liquids
- the skin, eg from contact with corrosive materials
- the body, eg from extremes of heat or cold
- PPE is needed in these cases to reduce the risk

PPE not only helps protect people but also improves productivity. Farmers and ranchers can benefit from using the appropriate protective equipment for themselves, family members, and workers when the job and its potential hazards call for it. Protective equipment must be carefully selected. Test fit the protective equipment to be sure of a proper and comfortable fit. If it isn't comfortable - it won't be worn; if it isn't worn -it won't protect.

3.2. Definitions of equipment protection

Eye and face protection - To provide protection during exposure to hazards like flying particles,

metal or sparks, liquid chemicals, caustic liquids, light radiation, i.e., welding, lasers.

Hearing protection - To provide protectionduring exposure to high pitch and loud noiselevels.

Respiratory protection - To provide protectionfrom inhalation hazards such as vapors, mists,particulates, pesticides, and gases.

Hand protection - To provide protection duringexposure to potential hazards such as sharpobjects, abrasive surfaces, temperature extremes,and chemical contact.

Head protection - To provide protection topotential hazards such as falling objects, strikingagainst low-hanging objects, electrical hazards, orchemical application.

Foot protection - To provide protection forsituations with the potential of injuries such asfalling or rolling objects, chemical or liquid exposures,piercing objects, and where feet are exposedto electrical hazards.Solutions for eye and face protection

I. Did you know...eye injuries are the leading cause of blindness among farmers andranchers?

Protective eyewear can prevent eye injuries in more than 90 percent of cases.Eye protection should always be worn where there is potential for injury to the eyes or face fromsmall particles, toxic chemicals, flying particles, large objects, thermal or radiation hazards, and lasers.According to the types and extent of hazards, different PPE should be worn. These must alwaysremain clean and free of contaminates.

Goggles

Goggles offer good protection against front and side impact. Unvented or indirect vented chemical splash goggles provide protection from chemical vapors and liquids.

Figuere 4: Goggles

II. Did you know...75 percent of all farmers and ranchers experience some form of hearingloss compared to 10 percent of the general public?

Thirty-three percent of all workers experiencing hazardous noise at work will develop noise-inducedhearing loss.Exposure to high levels of noise may result in hearing loss. PPE should be worn when the noiselevel is 85 decibels or greater averaged over an eight-hour period. Most hearing protection deviceshave a noise reduction rating (NRR) that indicates the amount of protection provided. In general, lookfor NRR of 25 or greater.

Earmuffs

More comfortable to wear and offers better long-term protection toloud noise than earplugs.However, noise reductionis not superior to properlyinserted earplugs.

Figures 5: earmuffs

III. **Did you know...agricultural workers encounter a variety of respiratory situations rangingfrom temporary discomfort caused by allergic reaction to fatalasphyxiation?**

The risk of contracting severe lung disease or death can be significantly decreased by using respiratoryprotection.Respirators are used to prevent the exposure to air contaminated with harmful dusts, fumes,mists, gases, smokes, sprays, or vapors. All respirator usage, including disposable respirators, air purifyingrespirators, and airsupplied respirators, require annual fit testing and training prior to use.

Offers protection against non-toxic solid andliquid aerosols (e.g., oil mists).
Exhalationvalve makes breathing easier and reduces hotair build up. Product must be discarded whenclogged.

figure 6-1: **Air purifying masks with exhalation valve**

Chemical cartridge respirators

Provide a higher level of protection than dust masks. Covers nose and mouth with valve to control air movement. Replaceable activated carbon cartridges filter incoming air.Requires fit test for proper fit andshould not be used with facial hair.

figure 6-2: **Chemical cartridge respirators**

IV. Did you know...hands are the body part most likely injured in agricultural settings accountingfor approximately 22 percent of all work-related, non-fatal injuries to adults onU.S. farms and ranches?

Selecting proper gloves is very important since the hands are used to handle hazardous materials. In addition, traumatic injuries such as cuts, sprains, and punctures may occur. With the wide range of hazards, there are also a wide range of gloves that may be used as PPE. Chemical-resistant gloves are always recommended when workingwith pesticides and chemicals. Chemical-resistant aprons add protection from body absorption of hazardous chemicals.

Vinyl/neoprene gloves

Protects hands against toxic chemicals. Selecting the right glove is critical in handling the varying level of chemical toxicity. See link below for description of protectivematerial used in

Figure 7-1: Vinyl/neoprene gloves

Padded cloth gloves

Protects hands from sharp edges, slivers, dirt, and vibration. Not acceptable for handling hazardous materials.

Figure 7-1: Padded cloth gloves

V. Did you know...head protection designed to reduce the force of impact from falling objectscan mean the difference between suffering a mild concussion or having permanentbrain damage?

Head injuries are commonly caused by impact from falling or flying objects and walking into hardobjects. PPE devices such as hard hats may protect one from objects contacting the head and, in alimited way, from electrical shock or burns.

Hard hats

(Class A) Offers protection from falling objects and electrical shocks up to 2,200 volts.
(Class B) Offers protection from falling objects and electrical shocks up to 20,000 volts.
(Class C) Offers protection from falling objects but not from electrical shocks or corrosive substances.

figure 8: hard hat

VI. Did you know... “When your feet hurt, you hurt all over?”

Proper footwear not only protectsfeet from injuries but also reduces the pain and fatigue that can lead to injuries.Injuries that may occur when proper footwear is not worn are chemical and heat burns from spillsof certain chemicals, compression injuries, electrical shocks, and slipping.

Nitrile footwear

Resists animal fats, oils, water, chemicals, and pesticides.

figure 8: Nitrile footwear

VII. Did you know...fashion may not be foremost on the minds of farmers and ranchers, butproper clothing is an important component of personal protective equipment?

Protecting the body with the proper clothing can help prevent injuries or contamination, or lessenthe impact of any that occur. Various farm and ranch jobs require different protective clothing.

Chemical-resistant coverallsand aprons

Coveralls and aprons (singleuseor reusable) worn overregular work clothing offeradditional protection whendiluting, mixing, or applyingpesticides. Pesticide labelsmay require them for certainpesticides.

Figure 9: Chemical-resistant coverallsand aprons

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is PPE in terms of waste managements (4 points)?
2. List common PPE (4 points)?
3. What is Respiratory protection (4 points)?

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

1. _____
   _____
2. _____
   _____
3. _____
   _____

Information sheet-4	**Selecting, checking, and maintaining tools and equipment**

4.1. What is a Tool?

Any physical item that is used to achieve a goal but is not consumed during the process can be defined as a tool. Tools are often also referred to as machine, apparatus, implements, instruments or utensils. The knowledge of obtaining, constructing and using tools is known as technology. Tools can perform a variety of functions such as cutting and chopping, moving, shaping, fastening, guiding, enacting chemical changes, fastening, information and data manipulation, etc. There can be specific tools designated for specific purposes whereas most tools can serve a combination of uses.

4.2. What is Equipment?

The idea of equipment represents all sorts of machinery, functional devices or accessories which serve an individual, household or a community purpose. Usually, a set of tools that are designated for a specific task is known as equipment.

4.3. Waste collection tools and equipment

4.3.1. Waste collection Equipment

Common waste collection chores include washing, disinfecting, and cleaning in corners, surfaces beneath fences, along partitions, in alleys, and installs or pens. Regularly cleaned, neat-appearing facilities reduce complaints about odors, insects, and other pests. Warm, moist, manures are ideal for pests and need to be frequently and thoroughly removed.

Shovels, forks, scrapers, brooms, brushes, pressure washers, and related hand tools (fig. 10) are needed for small area cleanup. A variety of hand tool heads and handles are available with handle angle (lie) and length variations for individual needs. A

straight-grained ash wood or fiberglass handle provides strength, grip, protection from electric shock, and handling comfort.

Figure 10: Hand tools used for waste collection

A short handle with an end D-grip permits heavier lifts and working in close quarters. A long handle provides better leverage for digging and throwing. Aluminum and plastic shovels are lightweight, rustproof, and non-sparking. The extra investment requiredand the relatively faster wear compared to steel should be considered in choosing these shovels. Forks are available with forged flat, oval, or round tempered steel tines in 3-, 4, 5-, and up to 12-tine (18-in) widths. These forks handle loose or heavy, wetwastes. The flat tines assist in getting under and holding coarse, chunky waste. The oval tine is stiff, and theround tine forks do not clog as easily as the flat or ovalones. A long-handle, relatively heavy floor scraper minimizes the labor of loosening stuck-on materials. Lightweight squeegees and scrapers are designed for cleaning anddrying wet, smooth surfaces. A scraper blade that can be reversed when worn doubles the blade life.Long, upright-handle brooms are used to sweep cornersand small spaces, even wet areas. Push broomsthat are up to 2.5 feet wide assist fast cleanup of largeareas. A broom that has short, flexible bristles isdesigned for sweeping lightweight dirt and dust fromsmooth surfaces. The long, stiff bristles are for rough,tough sweeping. Plastic bristles resist moisture andbacteria, but not heat. A secure head for the bristlesand handle attachment assists broom durability. Thechemical, solvent, fat, and oil resistance of the

bristlesshould also be considered in choosing a broom. Aflow-through handle assist in washdown cleaning.

Pressure washers (fig. 10), can provide up to 7,000pounds per square inch (psi) of water pressure toloosen and wash away hard, dried, stuck-on waste.Washers that have an optional electric, gas, or oilheater can heat the water or produce steam to helpspeed waste removal. Afuel per hour rat-ing is the measure of their efficiency. Power washers may be free standing, permanently installed, or truckmounted.Pressure washer selection considerations include:

- cost
- kind of cleaning desired (grease soil)
- pressure durability of the surface to be cleaned
- water supply quality and quantity needs
- cleaner-aid injection
- portability
- hose insulation and length
- heater fuel type
- washer corrosion protection
- available power source

A. Tractor scraper blades

Scraping and collecting wastes with a tractor rear- or front-mounted blade is relatively fast over large, flat areas. Tractor scraping requires operator time, however, and takes a tractor away from other uses.

Figure 11: Tractor rear scraper blade with vertical tilt

B. Lawn and garden size tractorscraping

A lawn and garden or compact tractor scraper have advantages for access, visibility, and agility over the larger tractors, but the capacity is less (fig. 12). The small tractors have a wide selection of other useful.

Figure 12: Lawn and garden tractor scraping equipment

C. Tractor front-end loaders

A tractor front-end loader (fig. 13) is perhaps the single most used multipurpose equipment item for waste handling.

Figure 13 Tractor front-end loader measurements

D. Skid steer and articulated loaders

Compact skid steer and articulated steer loader tractorsare especially designed for scraping and loadingsemisolid and solid wastes in small spaces (fig. 14).

Figure 14: Skid steer and articulated steer-type loaders

E. All-wheel drive front-end loader

The investment involved in purchasing a large, highcapacity, all-wheel drive bucket loader(payloader) is justifiable for a year-round, near daily operation (figs14).

Figure 14 All-wheel drive (agricultural bucket loader)

F. Motor grader

A common road grader and maintainer can be practicalfor frequent scraping of solid waste buildup onlong paved aprons and open yard surfaces.

Figure 15: Self-propelled, self-loading elevating scraper hauler

G. Mechanical scrapers for gutters andalleys

Open scrape alley design for semisolid and slurrywaste is explained in chapter 10 of this handbook. Therelatively light duty cable-drive scraper (fig. 16)can use manual or automatic control of a 0.75- to1.5-horsepower electric motor.

Figure 16: Cable-drive scraper for open alley or underslat floor

H. Conveyors and stackers

Most gutter cleaner equipment has unloading elevator ramp options for piling or stacking solid and semisolid waste onto outside storage piles and aboveground storage tanks.

Figure 18: Conveyors and stackers

I. Flushed gutters and alleys

Flush gutter and flush alley waste collection uses arelatively large quantity of regularly added flush waterfor more thorough cleaning. A flush waterrecycle arrangement reduces the amount of addedfresh water.

Figure 19: Hand-operated storage gate flush control

J. Multiple function equipment

Some pieces of equipment serve multiple functions.They are used for collection of manure at the sourceand transfer to a storage facility or for transfer fromthe collection point or storage facility to the utilizationarea. A piece of equipment that is used for both collectionand transfer of manure to a storage facility is a manure
vacuum (fig. 20).

Figure 20: Manure vacuum (Photo courtesy of Mensch)

4.3.2. Waste transfer equipment

transfer equipment can be an extension of the waste collection equipment. The equipment that has common use either for collection or for transfer of waste is explained in section. It includes:

- tractor front-end loader
- skid steer and articulated steer loaders
- all-wheel drive front-end loader
- ramps and bumper walls
- earth mover scrapers
- manure vacuum

K. Augers and conveyors

A standard pitch auger that is 0.3 to 1.5 feet in diameter can be used to transfer solid, semisolid,and liquid wastes. A clean auger intake and relatively tight auger fit within its housing assist throughput.

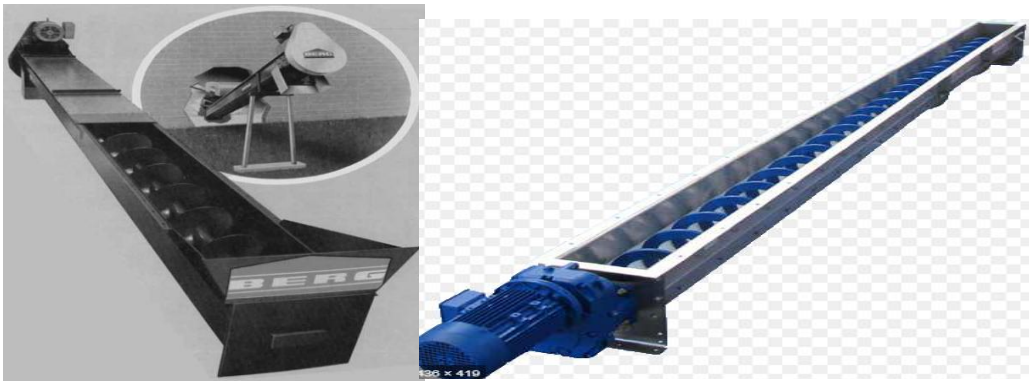


Figure 21: Auger elevator slurry waste conveyor

L. Pumps

A variety of air pressure and vacuum pumps, pistonplungerpumps, and either variable or positive displacementpumps move liquid, slurry, and semisolidwaste to storage, tankers, or irrigators. Pump selectionand rating depend on the amount and type of solids inthe waste

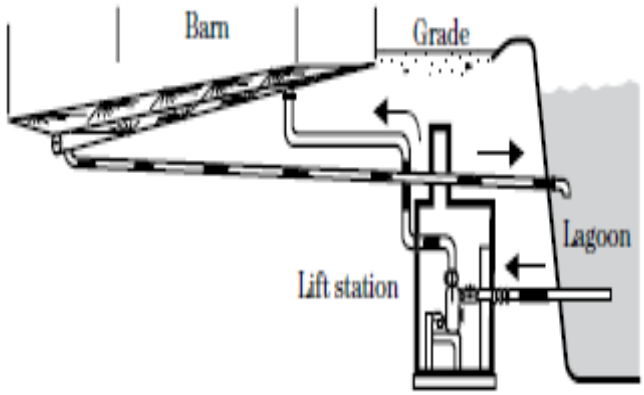


Figure 22: Large-volume, low-pressure flush pumpused in a recycle system

M. Transfer

Generally, two types of pumps, submersible andvertical shaft centrifugal, pump liquid and slurry waste from reception storage to long-term storage orseparation. The relatively small, submersible, 0.5- to15-horsepower centrifugal-type (sump) pump (fig. 23)

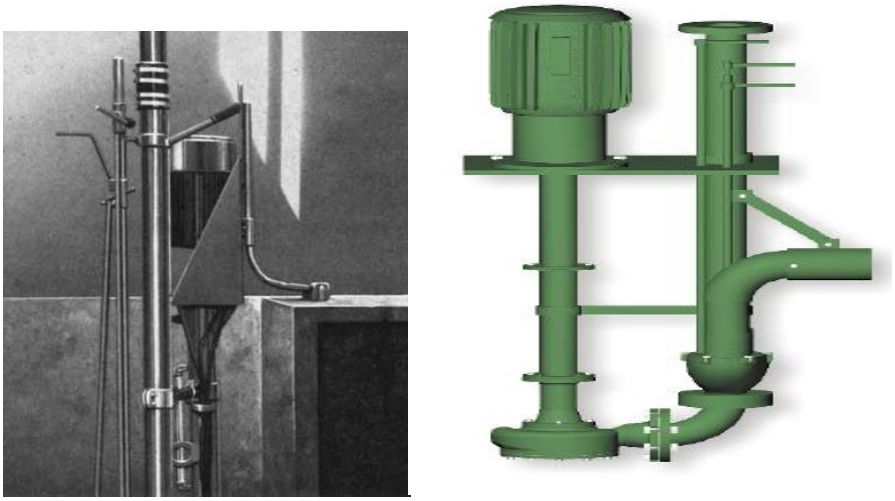


Figure 23: Submersible and vertical shaft transfer pumps

N. Chopper-agitator pump

The vertical shaft and inclined shaft chopper-agitator pump typically employs a 10- to 20-inch-diameter semienclosed impeller. This impeller has a relatively wide clearance, which helps to avoid plugging.

O. High pressure and capacity

Centrifugal pumps with a horizontal power shaftand closed impeller are available. These pumps areengineered with close tolerances, securely sealedbearings, balanced power shafts, and other featuresfor sustained operation at high rpm's, pressure, andthroughput.

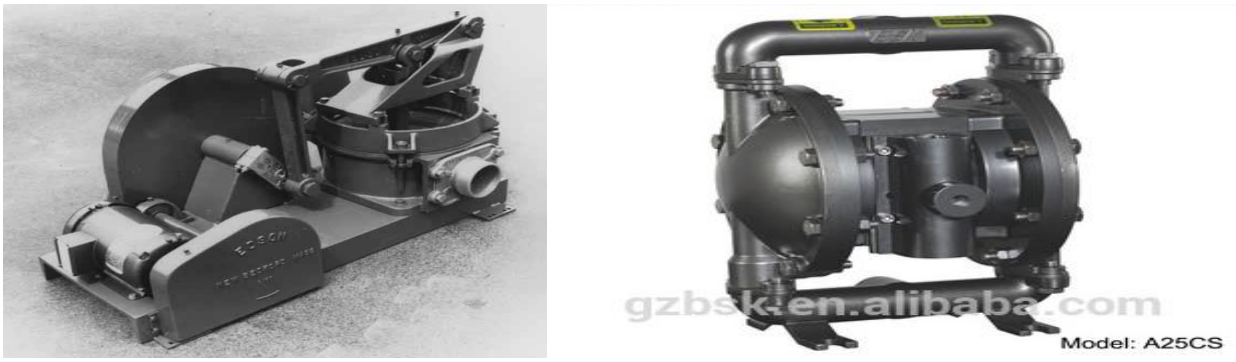


Figure 24: Diaphragm pump (Photo and drawing)

P. Helical rotor

A helical rotor, or rotary screw, pump (fig. 24)can pump liquid, slurry, and semisolid wastes at pressures of up to 450 pounds per square inch.

Figure 25: Helical rotor pump

Q. Air-pressure and vacuum waste pumping

An air-pressure (pneumatic) operated semisolid and slurry waste pump uses a well-constructed belowground collection or holding tank that can be closed and pressurized with compressed air (fig. 26).

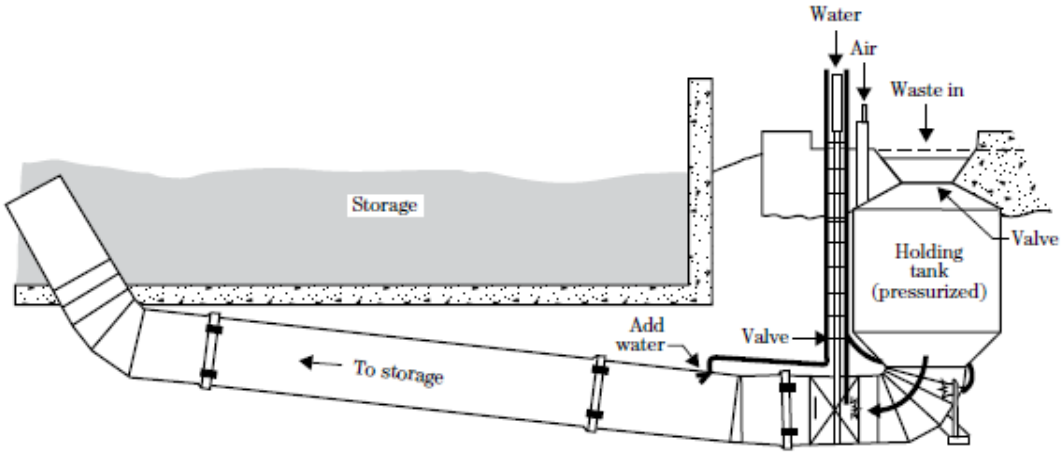


Figure 26-A: Air pressure chamber (pneumatic) waste pump

Piston-plunger pumps

Piston pumps have been developed to convey slurry, semisolid, and solid waste from a gutter cleaner or reception storage hopper to long-term storage (fig. 12–40)

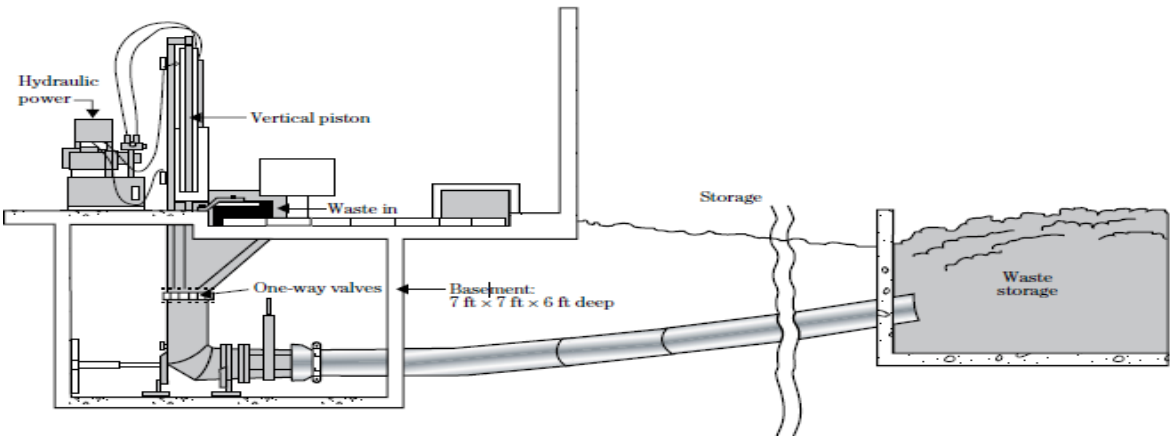


Figure 26 -B Vertical piston plunger waste pump with a pipe anchor

3.3.3. Waste storage

equipment

The primary concerns about waste storage include pollution prevention, capacity, cost, durability, nutrient retention, safety, in-use appearance, odors, and expansion. Equipment used with stored waste can bean integral part of the storage (e.g., drive ramp access).

I. Storage interior accessing

A paved ramp is usedfor clean out and service access to waste storages.A paved ramp may also be appropriate for structuralstorage facilities. A corner location takes advantageof the existing minimum slope for installation.

II. Storage exterior accessing

Waste storage agitation and emptying equipment needsoverhead clearance and turning space access

Figure 27: Horizontal shaft chopper-agitation pump

III. Storage fencing with gates

A fence with locked gate entry is often used with anearthen basin and other open-top waste storage tocontrol access by people and livestock.

IV. Covers, drainage, and runoff control

Covers are placed on manure storage/treatment facilitiesfor several purposes including: odor and air emissionscontrol, rainfall exclusion, and biogas (methane)
capture.

Figure 28: Closed-cell floating cover

3.3.4. Waste treatmentEquipment

I. Size reduction

Cutters and shredders are used in agricultural wastetreatment primarily to reduce the size of relativelydry materials used for bulking agents in the compostingprocess. Most of this equipment has been adaptedfrom timbering operations.

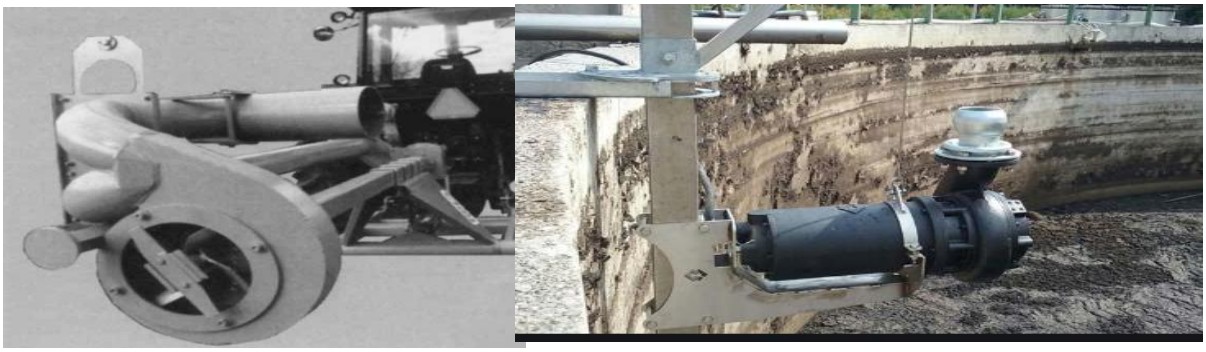


Figure 29: Cutter blade on chopper-agitator pump

II. Agitators, stirrers, mixers

Agricultural wastes usually contain materials of differentdensities. These tend to separate out during handling,storage, and use, especially with the more slurrywaste. Soil and other dense materials settle over timewhile straw, feathers, and another bulky materials float.

1. Semisolid and slurry waste agitators

Although useful with liquid waste, vacuum tankeragitation usually is insufficient with semisolid waste,especially where there is a surface crust. Chopper-agitatorPTO-driven pumps are designed to agitate as wellas pump semisolid waste.

Figure 30-A: Vertical shaft PTO-powered chopper-agitator Pump and **Figure 30 -B:** Vertical shaft chopper-agitator pump with

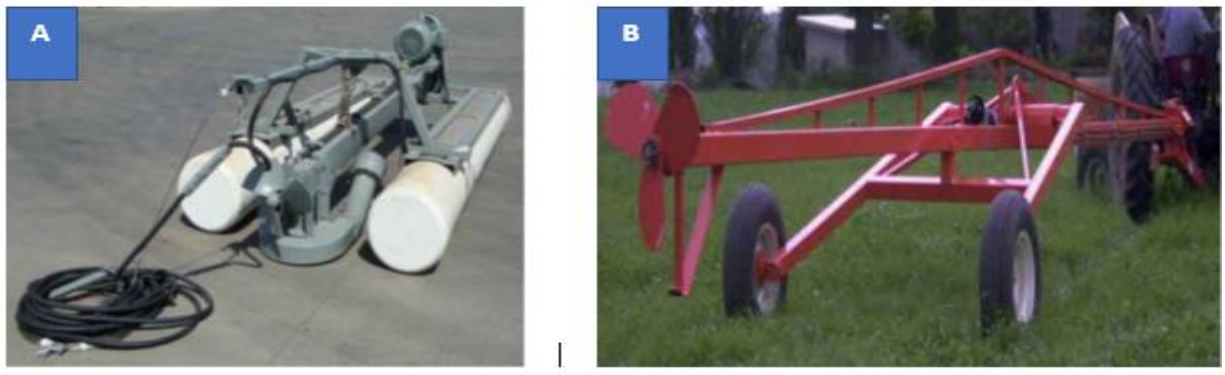


Figure 31-A: Float-mounted agitator pump and **Figure 31-B:** Open-impeller agitator

2. Solid waste agitators/mixers

Stacked or piled waste settles and shrinks as it decomposesand dries. Compost methods use agitation/mixing equipment to mix dry and wet materials andprovide airways (aeration) that aid decomposition.

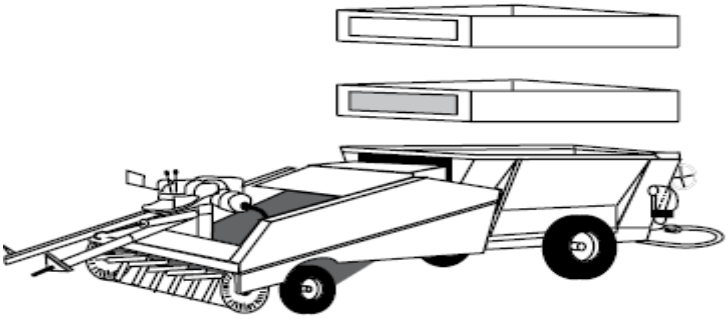


Figure 32: Elevator scraper for solid waste agitation and hauling

III. Aerators

The continual forcing or mixing of air with storedwaste affects its odor and temperature control aswell as the decomposition rate. Equipment has beendeveloped for aeration of solid, semisolid, slurry, andliquid wastes. While the use of agitator equipment withstored waste also aerates, the aeration result is nonuniformand relatively temporary.

Figure 32-A: Floating aerators for liquid waste aeration

Figure 32-B: Diffused air liquid and slurry aerator

Self-Check -4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is tool and equipmentinterims of dairy waste managements(4 points)?
2. List common tools and equipment that used for dairy waste mane (4 points)?
3. What is Cable-drive scraper (4 points)?

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

1. _____

   _____

2. _____

   _____

3. _____

   _____

Operation Sheet-1	Identifying OHS hazards and assessing risks

1. Inspect the Workplace when you operating to dispose dairy waste.

Step 1 - Identify hazards

Step 2 - Assess risks

Step 3 - Control risks

Step 4 - Review control measures

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within

Task 1- Identifying OHS hazards and assessing risks

Reference

United States Department of Agriculture Natural Resources Conservation Service. 2011. Agricultural Waste Management Field Handbook

Oklahoma Cooperative Extension Fact Sheets are **also available on our website at:** http://osufacts.okstate.edu

Dr. David Douphrate, PhD, MPT, MBA, CPE, CSP University of Texas School of Public Health (NIOSH Ag Center Affiliation: High Plains and Intermountain Center for Agricultural Health and Safety; and Southwest Center for Agricultural Health, Injury Prevention and Education)

Randolph Weigel Project Director – Wyoming AgrAbility University of Wyoming Extension.2012. Personal Protective Equipment for Agriculture.

DAIRY PRODUCTION

LEVEL-III

Learning Guide -64

Unit of Competence: - Implement dairy farm waste management

Module Title: - Implementing dairy farm waste management

LG Code: AGR DRP3 M17LO02-LG64

TTLM Code: AGR DRP3TTLM1219 -v1

LO2: Determine dairy farm west

Information sheet	Learning Guide #64

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Identifying Chemical Wastes in The Dairy Farm
- Identifying Waste Management Methods

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Chemical wastes in the dairy are farm identified
- Waste management methods are identified

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1 and proceed other turn by turn”
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1 and do the same on other self-check of information sheet).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to previous Learning Activity.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information sheet-1	Identifying Chemical Wastes in The Dairy Farm

1. **What Is Dairy Waste?**

Dairy waste includes milk, milk products and all dairy processing wastes that do not meet applicable quality standards, have become contaminated, or otherwise have become unusable for human consumption, animal feed, animal manure or any other beneficial use.

1.2. Pollution Risks Associated with Dairy Products

1.2.1. Milk

The first step in the production of milk powders is thecreation of milk condensate. This involves the evaporationof water and the creation of a large amountof condensate, which is normally clean but can becontaminated with milk residues. If contaminated, thiscondensate must be treated.

Table 1: quantities of wastewater produced during milk processing

Types of product	Wastewater volume (L/kg of milk processed)
White products (milk, cream and yoghurt)	3
Yellow products (butter and cheese)	4
Special products (milk/whey concentrates and dried milk products)	5

1.2.2. Cheese

A large proportion of the milk used in cheese manufacturingends up as whey (~90%). Whey consists ofapproximately 55% of the total nutrient content of milk.The effectsthat whey has on the polluting potential ofthe waste outputs from cheese production are shown inTable 2.

Table 2: composition of cheese manufacturing wastewater

	Processing plants with whey recovery	Processing plants without whey recovery	Urban wastewater treatment regulation limits
BOD (mg/L)	2397	5312	25
COD (mg/L)	5312	20,559	125
Fats (mg/L)	96	463	35
Nitrogen (mg/L)	90	159	N/A
Phosphate (mg/L)	26	21	N/A

N/A, not available.

1.2.3. Butter

The process of creating butter creates large amounts of buttermilk (the liquid left over after fats have been removed from the cream). This buttermilk can then be used in animal feed or be incorporated into dairy or bakery products as an emulsifying agent (Vanderghemet al., 2010). “cleaning-in-place” (CIP) also contributes to the waste generated during butter creation, as described below.

1.2.4. Cleaning in place

The majority of wastewater from dairy processing is generated by cleaning operations. Most of these cleaning operations are CIP methods. The definition of CIP in the context of the dairy processing industry is the circulation of cleaning (and sanitising) liquids through the milk processing equipment under conditions of increased turbulence and flow speedCIP during dairy processing involvesseveral steps: the recovery of any residual product (ifpractical); a pre-rinsing step with water (usually heated);cleaning with detergent(s); rinsing with clean water towash out any residual detergent; and sanitation.

1.2.5. Water usage

Water usage, either the use of municipal supplies oron-site wells, is a major expense for dairy processors.The typical amount of water used by dairy processorsto process a

literof milk varies worldwide. A typical dairy processer in the UK uses 1.3 L of water for every 1 liter of milk that is processed. Water consumption in the rest of Europe has been reported to range from 0.2 to 11 L water/L of milk processed (Daufin et al., 2001). In Australian dairy processing plants, water consumption varies for mixtures of white milk products, cheese, powders and yoghurts, ranging from 0.07 L water/L milk (for milk powders) to 2.90 L water/L milk (for yoghurts), with the average being around 1.5 L water/Lmilk (Prasad et al., 2004).

2.2.6. Dairy cattle manure

Dairy cattle manure is a complex material containingfeces, urine, bedding, rain or other water, andmilkhouse or washing wastes (Midwest Plan Service1975a). This material contains all of the macronutrientsneeded for crop growth and has particularly highamounts of nitrogen (N), phosphorus (P), potassium(K), and calcium (Ca). In addition to its nutrient value,application of dairy cattle manure to cropland isknown to improve soil organic matter and tilth(Klausner et al. 1974, Christensen et al. 1981).

Self-Check -1	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is dairy waste (4 points)?
2. List common dairy production waste (4 points)?
3. What is dairy manure (4 points)?

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

1. _____
   _____
2. _____
   _____
3. _____
   _____

Information sheet-2	**Identifying Waste Management Methods**

Depending on the location and the management's personal values, each farm can have different environmental concerns. Those in a watershed that supplies drinking water may be more interested in controlling pathogens and phosphorus. Those with a fresh water lake may be more concerned with sediment and phosphorus. Those with neighbors may be more concerned with odors. Those in a porous aquifer may be more concerned with nitrogen leaching and pathogens. Others may only be concerned about BOD loading that because fish kills locally. Nutrient loading far downstream may be a concern to some farms. Waste treatment methods will be required to deal with each of these issues. Some farms are interested in mass reduction to facilitate waste movement off their farm. Development of by-products that can be sold at a profit off the farm could help maintain profitability while improving the environment. There are many management issues that affect the choice of a waste treatment system ;Some of these issues include:

- minimize environmental damage
- maximize nutrient value
- minimize neighbor problems
- minimize damage to the land
- minimize cost
- minimize frustration

The following table describes some waste management alternatives that either are being used or are proposed.

Waste Management Alternative	Advantages	Disadvantages
Daily Spreading is being practiced by many farms. Manure and other wastes are spread as they are produced throughout the year.	Capital costs are low. Environmental effects are hidden. Odor problems are minor. Labor and equipment use is steady.	Total costs may be high. Nutrient and pathogen losses during times of saturated soils may provide excessive delivery to waterbodies. Field accessibility may be a problem.
Liquid Storage: to reduce spreading during high loss and times when fields are inaccessible. Required in many areas, encouraged in all areas.	Nutrient management can be easier. Efficiencies in handling can be obtained to keep costs down. Manure can be spread when needed.	Odors are a big problem when spreading. Large liquid handling equipment needs to be available. Labor and equipment need peak. Non-earthen storage can be very expensive. Catastrophic failure or heavy rainfalls right after spreading can cause peak pollutant discharges.
Solid Separation: of the manure solids mechanically can produce a "solid" portion (15-30% DM) and a "liquid portion"	Liquids are easier to handle. Solids can be recovered for bedding, soil amendment, or exported off the farm.	High capital and operating costs. Maintenance of the equipment is a problem. Marketing of the solids may not be successful on

(4-8% DM).		all farms.
Composting: of the manure by adding bedding or an amendment to produce a biologically decomposed product has had very limited success on farms.	Odor reduction is an important advantage of composting. Equipment for solids handling is available on most farms. Storage of solids is safer environmentally than liquid storage. Material may be marketed.	High moisture contents of most manure makes conventional composting difficult. Sales may depend on expensive specialized mixing equipment and good management. Composting outside on large areas can create runoff losses.
Bio drying: of the manure by recycling dry compost as the amendment to composting, and using the heat generated in the aerobic decomposition to dry the manure/compost mix with forced air has been proposed.	Odor reduction, volume reduction, and weight reduction would occur. Equipment for solids handling is available on most farms. Storage of solids is safer environmentally than liquid storage. Material may be marketed.	Management of drying process will be critical. Costs of operation may be high. Material handling may be excessive. Additional amendment may be required. Winter operation may require closed buildings.
High Solids Anaerobic Digestion: would produce a decomposed residual and produce methane gas. Heat from the gas or from an engine generator could be used to dry the material for recycling within the	Odor reduction, volume reduction, and weight reduction would occur. Equipment for solids handling is available on most farms. Storage of solids is safer environmentally than liquid	Management of digestion and drying process will be critical. Capital costs will be high. Electric utility connections may be difficult. Material handling may be excessive. Additional amendment

system. This system has been tried experimentally on dairy manure.	storage. Material may be marketed. Energy production would meet the needs of the farm and allow excess to be sold.	may be required.
Anaerobic Digestion: takes as produced manure and digests it producing an odorless effluent that has reduced solids content while retaining the nutrients. Methane gas is recovered that can be used to run an engine generator.	Odor reduction and energy recovery will occur. Effluent is reduced in solids content and can be further reduced easily by mechanical solid separation. Demand for the anaerobically digested solids is greater than raw solids.	Management of digestion process will be critical. Capital costs will be high. Electric utility connections may be difficult.
Lagoon Treatment: of manure from the farms consists of diluting the manure, allowing it to settle in large shallow pools then flow to a facultative lagoon to be recycled as flush water to dilute more manure. Liquids and solids are periodically removed from the system.	Odors are reduced and solids are separated without mechanical treatment. Works well with a flush system to remove manure from barns. Solids may be marketed. Liquids can be easily irrigated. Management is relatively easy.	Solid harvesting and dewatering can be difficult. Exposure of large surface areas may result in extra water volumes. Impermeable soils on moderately flat terrain are required to keep cost down.

Self-Check -2	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are alternative waste managements (4 points)?
2. List factors that affect to select waste management methods (4 points)?
3. What are advantages managing waste by composting (4 points)?

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

1. _____
   _____
2. _____
   _____
3. _____
   _____

Reference

https://www.journalofdairyscience.org › article › pdf

https://www.sciencedirect.com › science › article › pii

https://www.fao.org ›

DAIRY PRODUCTION

LEVEL-III

Learning Guide -65

Unit of Competence: - Implement dairy farm waste management

Module Title: - Implementing dairy farm waste management

LG Code: AGR DRP3 M17LO03**-**LG65

TTLM Code: AGR DRP3TTLM1219 -v1

LO 3: **Maintain and operate a dairy waste storage and disposal system**

Information sheet	**Learning Guide #65**

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Observing and following organizational OHS procedures.
- Using dairy waste disposal systems
- Flushing and draining in-shed dairy waste pits

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Observe and follow Organizational OHS procedures, practices, policies and precautions, including the use of PPE.
- Service and maintain Dairy waste removal and disposal equipment correctly.
- Use Dairy waste disposal systems according to system design in compliance with approval granted by local government and the State environment protection authority.
- Carry out Recognized techniques for irrigation from dairy waste storages according to.
- Flush and dray In-shed dairy waste pits as required.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1 and proceed other turn by turn”
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1 and do the same on other self-check of information sheet).

6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to previous Learning Activity.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information sheet-1	**Servicing and maintaining dairy waste**

	removal and disposal equipment correctly.

1.1. Job roles and responsibilities

Every job will have roles and responsibilities attached to the position outlining the work to be done, and responsibilities for items such as cash, equipment, service delivery and other issues relevant to the role.

1.2. OHS roles and responsibilities for individual positions

The OHS roles and responsibilities for each job position must be provided to new staff as part of their Induction and Orientation.Examples of OHS-related roles attached to individual workplace jobs may include:

Participation in the workplace OHS structure such as:

- Attending designated OHS meetings
- Being designated as an office bearer within the venue‟s OHS structure – for example, the tasks associated with being:
- Health and Safety Representative/OHS representative
- Secretary of OHS Committee

Being the person in a department or area designated as the „Safety Officer‟, „Area Warden‟ or similar Provision of OHS training support to internal venue trainers specializing in OHS issues. Examples of OHS-related responsibilities attached to individual workplace jobs may include:

- Operating equipment and systems (as identified in the Job Description) in a safe manner
- Identifying and reporting unsafe situations with equipment and systems (as identified in the Job description)
- Providing service and maintenance to equipment and systems (as identified in the Job Description)
- Following the venue requirements for internal reporting of accidents,

- injuries and (where applicable) „near misses"
- Complying with workplace SOPs designed to ensure workplace safety.

1.3. Generally applicable OHS responsibilities for employers and employees

In addition to the responsibilities attaching to each job position, employees and employers have other generic OHS responsibilities. These responsibilities may be enshrined in OHS legislation. If they are not legal requirements, they are certainly „best practice" to help ensure workplace safety.

1.3.1. Employer responsibilities

OHS legislation outlines employer and employee responsibilities.

Employer responsibilities across all business types should include:

- Providing safety training and clear safety rules
- Encouraging a Health and Safety Committee or similar body. The aim of the committee is to identify areas in the workplace where changes should be made so as to create a safer working environment. This may include upgrading equipment, equipment, training and safety matters
- Maintaining an injury register to record accidents for insurance and monitoring purposes
- Adhering to all workplace agreements and contracts in relation to the work employees are required to undertake. Where staff are being asked to perform tasks, they are not familiar with or have not been trained in, there is a higher risk of injury
- Providing information and written instructions in appropriate languages other than English where significant workers are from a non-English speaking background
- Providing all necessary safety equipment to allow staff to perform required work safely. This may include gloves, masks, ear protectors, goggles, protective clothing and footwear

- Maintaining a safe workplace for their employees and monitoring health and safety issues. For example, equipment and machinery must be maintained and must conform to safety standards
- Providing well-lit and ventilated places to work
- First aid must be provided to all employees when and where necessary. This covers employees when they are coming to and from work via the shortest practicable route, provided the accident is not self-inflicted or of a malicious or wilful nature.

1.3.2. Employee responsibilities

All employees across all industries have the following responsibilities:

- Work in a way to ensure personal safety, and the safety of others including colleagues
- and/or customers
- Use safety equipment in accordance with the manufacturer's instructions and the directions or training of the employee
- Use all safety equipment when and where required according to workplace instructions and training
- Follow all occupational health and safety procedures, practices and protocols in line with establishment requirements and the training received in relation to these
- Report accidents, injuries or illness to the appropriate person and record same on nominated forms or documentation
- Report any equipment in need of repair so appropriate service and maintenance can be provided
- Adhere to all legally imposed OHS requirements
- Not interfere or get in the way of a person, such as a first aid provider, who is trying to assist another in need.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are job roles and responsibilities (4 points)?
2. What are employer responsibilities (4 points)?
3. What are employee responsibilities (4 points)?

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

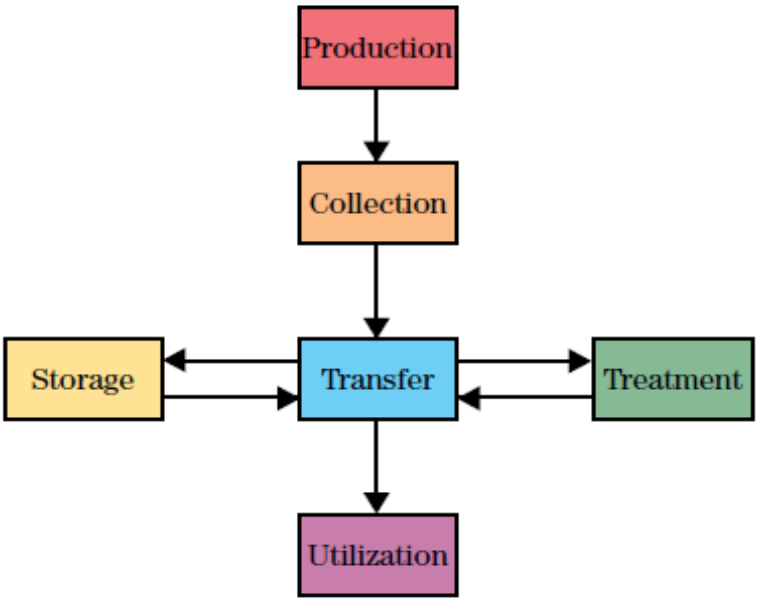
1. _____
   _____
2. _____
   _____
3. _____
   _____

Information sheet-2	**Using dairy waste disposal systems**

2.1. Typical agricultural waste management systems

2.1.1. Dairy waste management systems

Dairy operations vary, and each operation presents its own unique problems (fig. 1). Many older dairy operations were not designed with sufficient consideration given to waste management. As a result, the design of a waste management system may require major modifications or alterations of existing facilities.



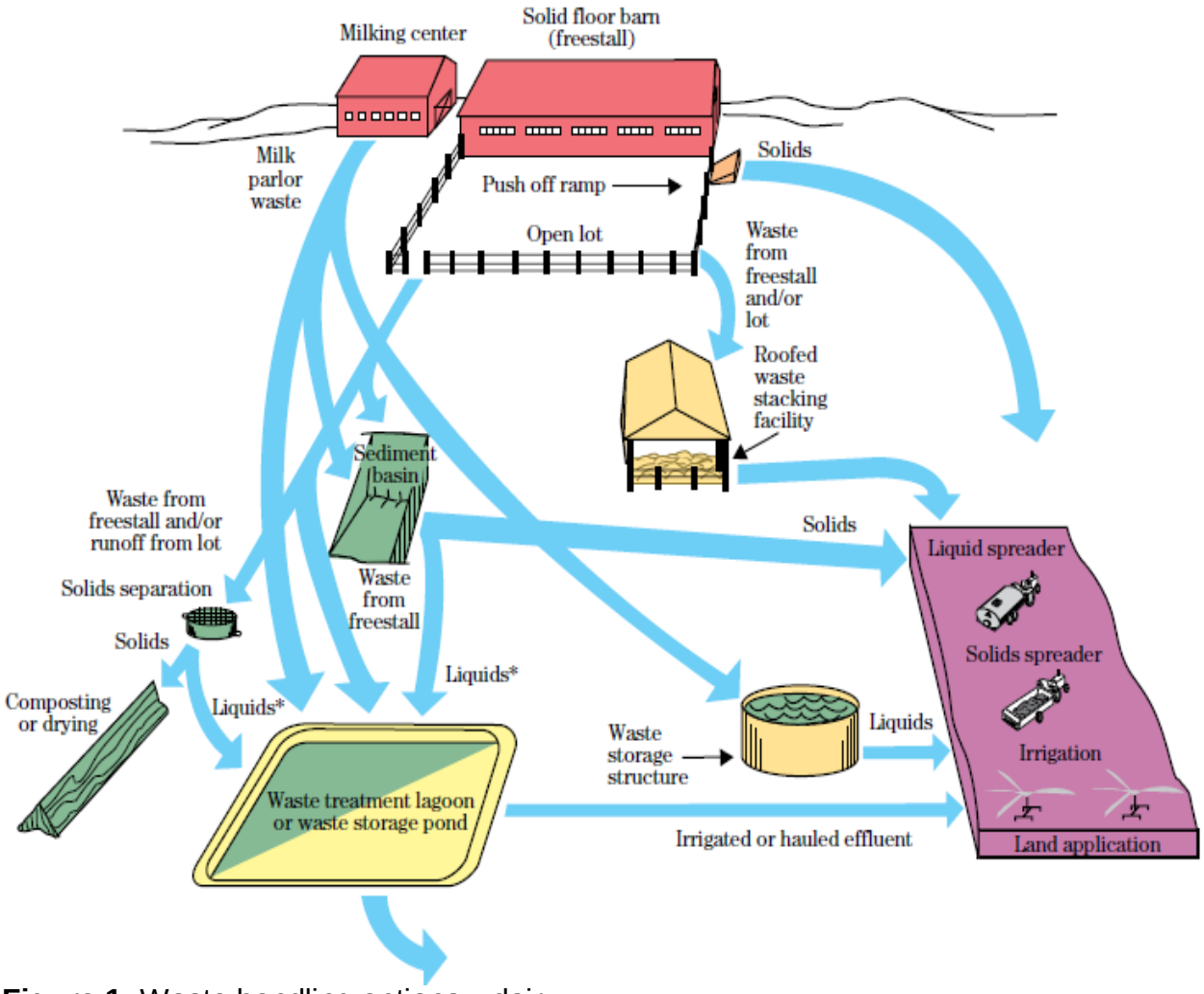


Figure 1: Waste handling options—dairy

The dairy industry generally is concerned with the overall appearance of the dairy farms. Dairy operations require high standards of sanitation and must prevent problems associated with flies. Operations near urban areas must manage the waste in a manner that minimizes odors.

Small dairy operations are commonly managed on pastures in partial confinement. While animals are on pasture, their waste should not be a resource concernif stocking rates are not excessive, grazing is evenly distributed, manure from other sources is not applied, and grazing is not allowed during rainy periods whenthe soils are saturated. To

prevent waste from accumulating in feeding, watering, and shade areas, the feeding facilities can be moved, the number of wateringfacilities can be increased, and the livestock can be rotated between pastures. To reduce deposition of waste in streambeds, access to the stream may be restricted to stable stream crossings and access points (fig. 2).

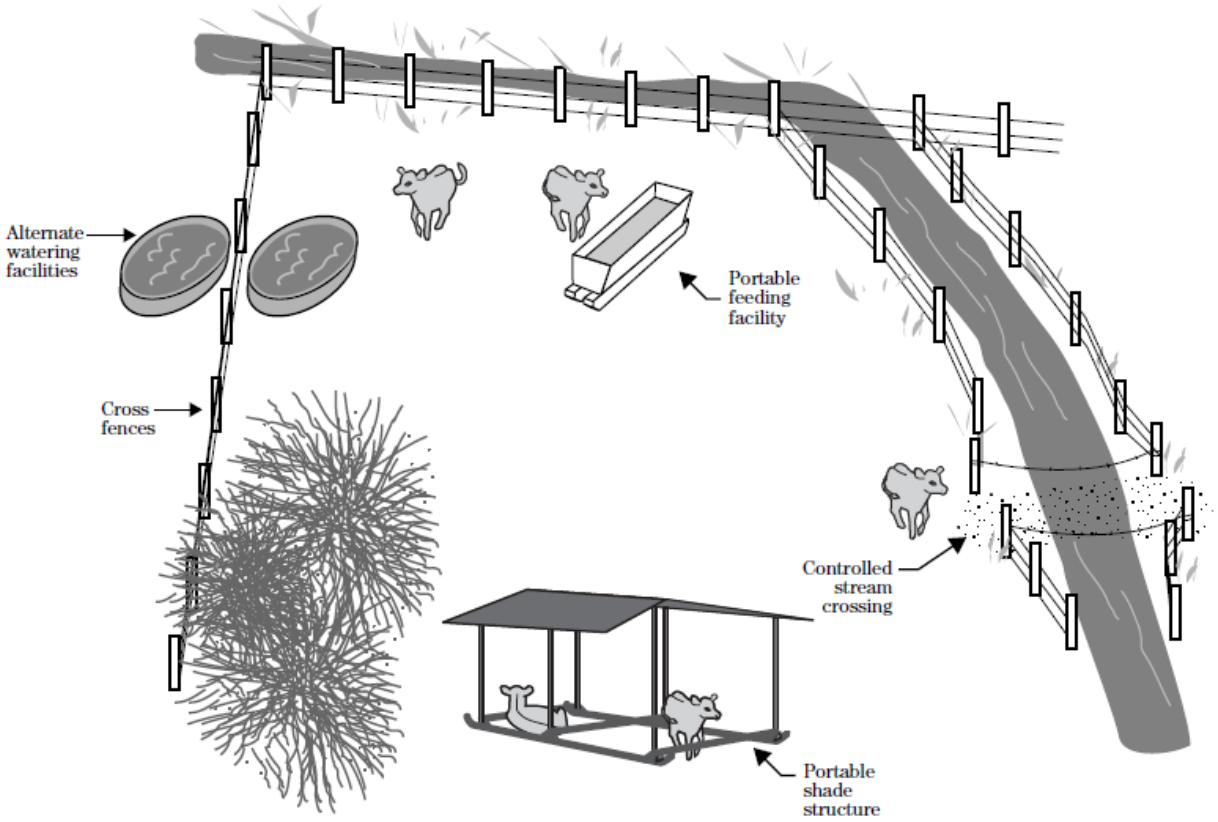


Figure 2: Waste management for dairy or beef on pasture

The manure in paved holding areas generally is easier to manage, and the areas are easier to keep clean. If the holding areas are unpaved, the traffic of the livestocktends to form a seal on the soil that prevents the downward movement of contaminated water. Care must be taken when removing manure from these lots so that damage to this seal is minimized.Most medium and large dairy facilities are managed as total confinement. All of the manure and associated waste components must be included in the AWMS.

I. Production

Waste associated with dairy operations includes manure, contaminated runoff, milking house waste, bedding, spilled feed, and silage leachate.

II. Collection

The collection methods for dairy waste vary depending on the management of the dairy operation. Dairy animals may be partly, totally, or seasonally confined.Manure accumulates in confinement areas and in areas where the dairy animals areconcentrated before and after milking.

Unroofed confinement areas must have a system for collecting and confiningcontaminated runoff. This can be accomplished by using curbs at the edge of thepaved lots (fig. 3) and reception pits where the runoffexits the lots. Paved lots generallyproduce morerunoff than unpaved lots. On unpaved lots, the runoffmay be controlled by diversions, sediment basins, andunderground outlets. The volume of runoff can be reducedby limiting the size of the confinement area, anduncontaminated runoff can be diverted if a roof runoffmanagement system and diversions are used.The manure and associated bedding accumulated inroofed confinement areas can be collected and storedas a solid. The manure can also be collected as a solidin unroofed lots in humid climates where the manureis removed daily and in unroofed lots in dry climates.Manure can be removed from paved areas by a flushingsystem. The volume of contaminated water producedby the system can be greatly reduced if provisionsare made to recycle the flush water.

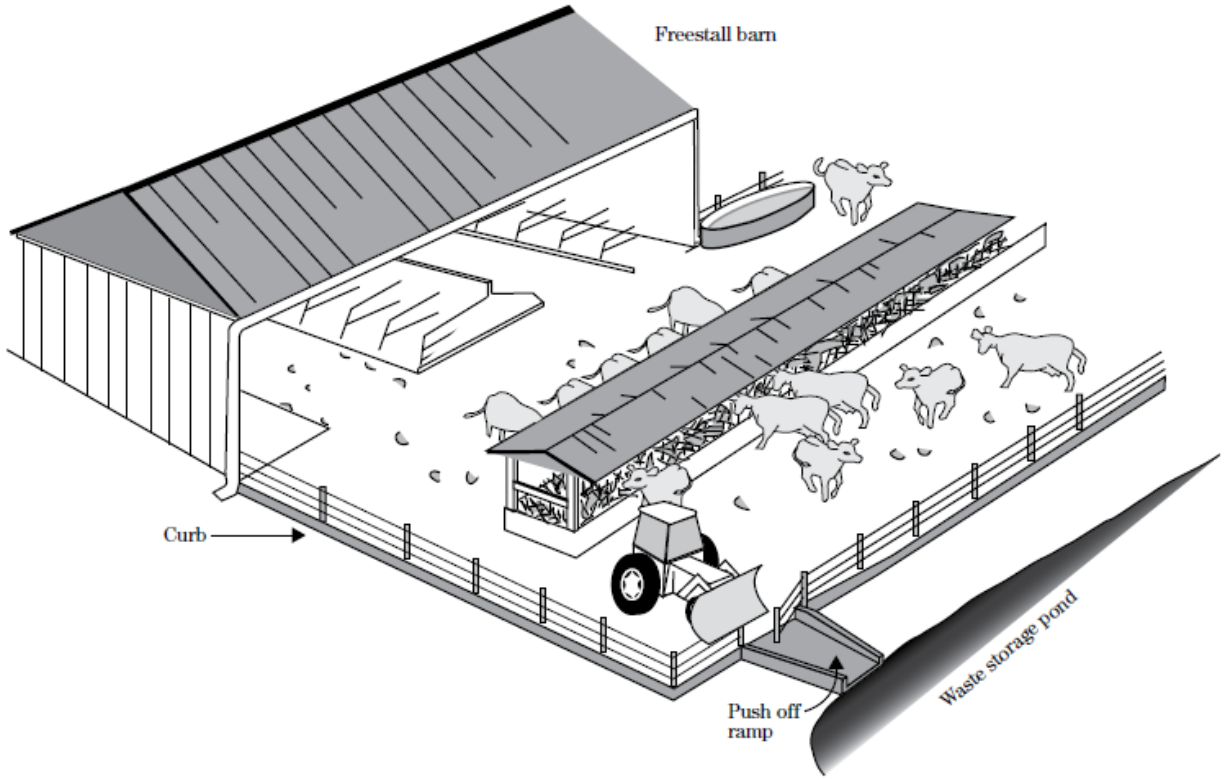


Figure 3: Confinement area with curbing

III. Transfer

The method used to transfer the waste depends largely on the consistency of the waste. Liquid and slurry wastes can be transferred through open channels, pipes, or in a portable liquid tank (fig. 4). Pumps can be used to transfer liquid waste as needed. Solid and semisolid waste can be transferred by mechanical conveyance equipment, in solid manure spreaders, and by pushing them down curbed concrete alleys. Semisolid waste has been transferred in large pipes through the use of gravity, piston pumps, or air pressure.

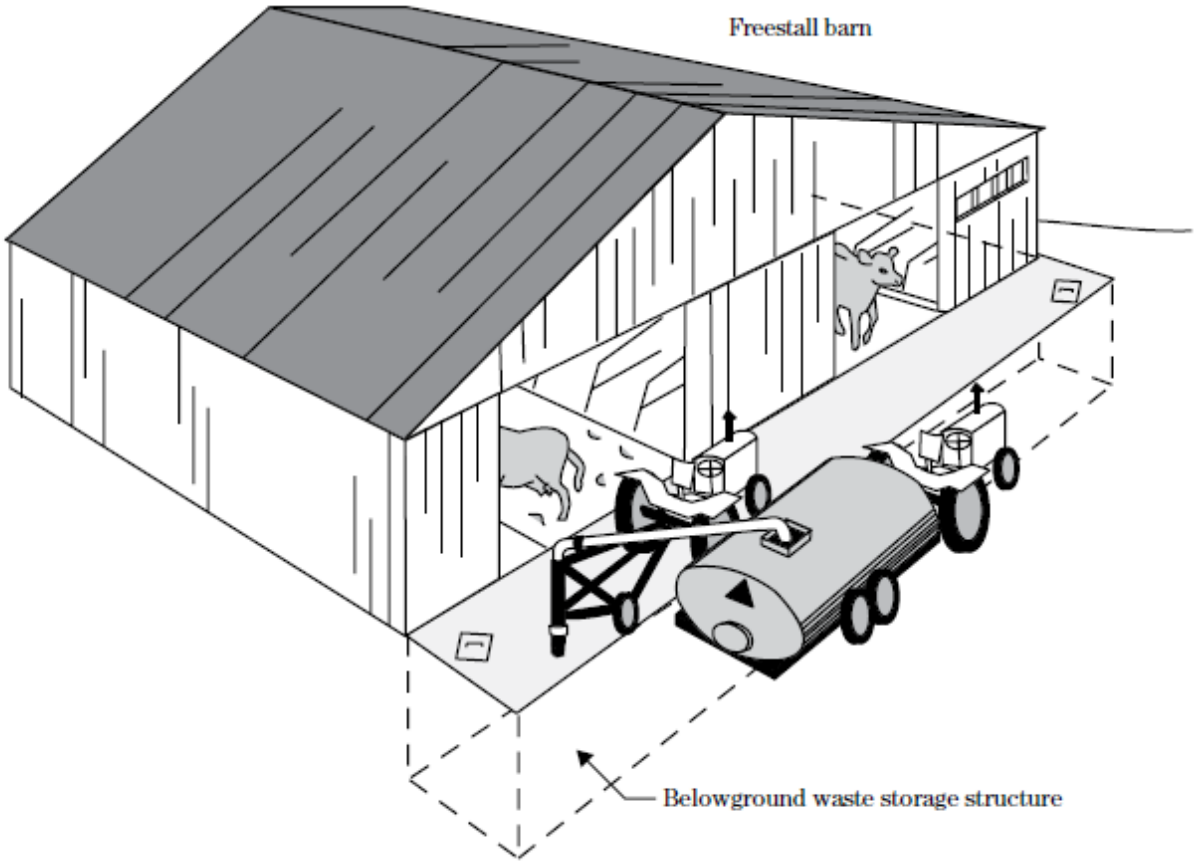


Figure 4: Tank wagon used to spread liquid wastes from belowground storage structure

IV. Storage

Milking house waste and contaminated runoff mustbe stored as a liquid in a waste storage pond or structure.Manure may be stored as a slurry or liquid in awaste storage pond designed for that purpose or in astructural tank (figs.5 and 6). It can be stored as asemisolid in an unroofed structure that allows for thedrainage of excess water and runoff or as a solid in adry stacking facility. In humid areas, the stacking facilityshould have a roof.

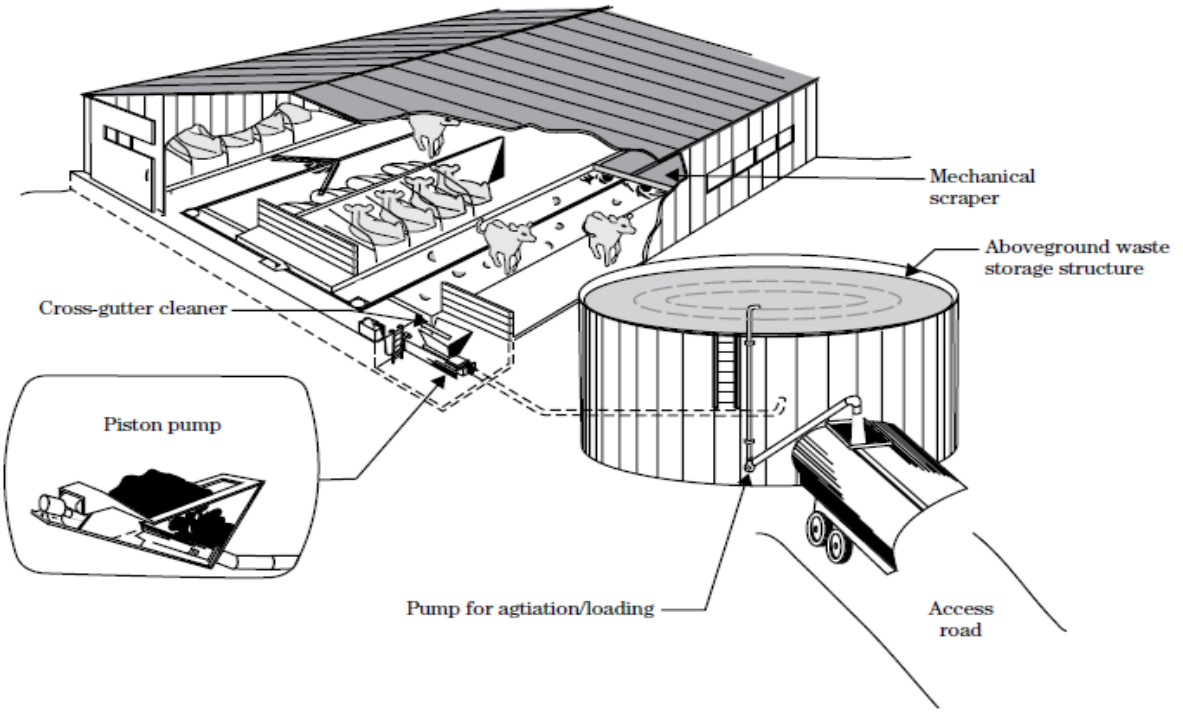


Figure 5: Aboveground waste storage structure

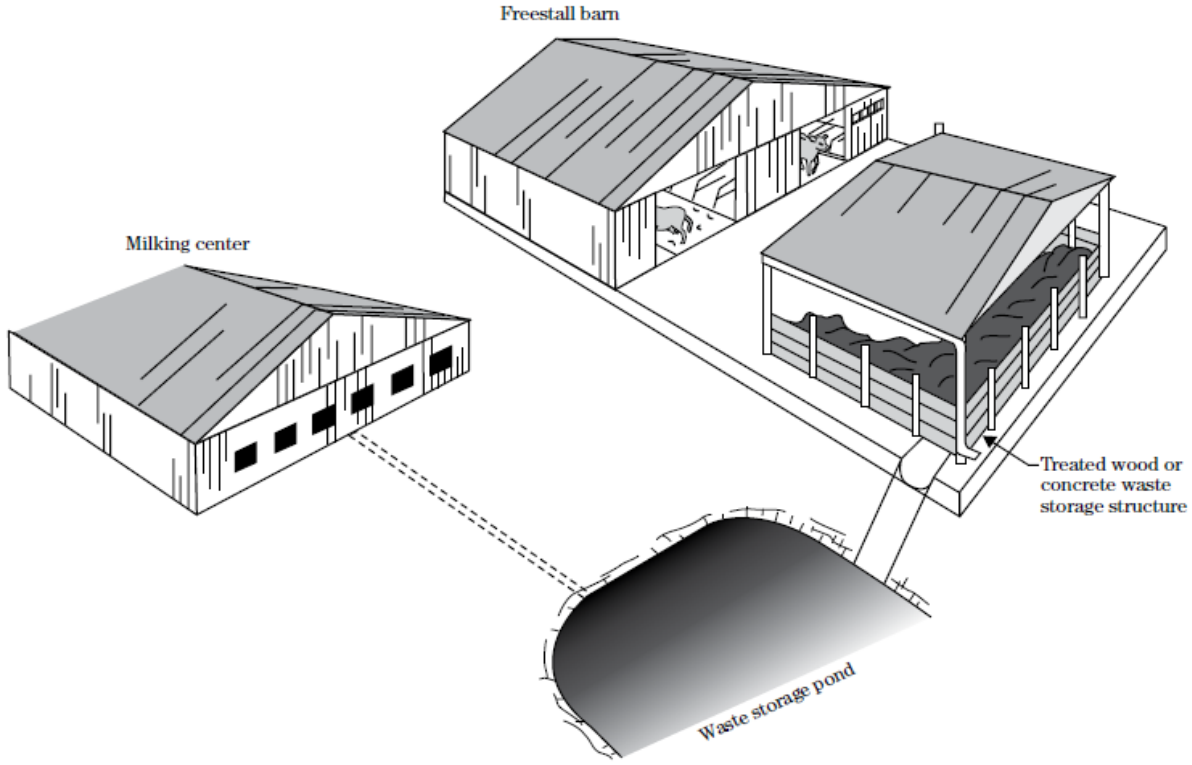


Figure 6: Storage facilities

V. Utilization

Dairy waste is used as bedding for livestock, marketed as compost, and used as an energy source, but the most common form of utilization is through land application. Waste may be hauled and distributed over the land in a dry or liquid manure spreader. Liquid waste can be distributed through an irrigation system. Slurries may be distributed through an irrigation system equipped with nozzles that have a large opening (fig. 7).

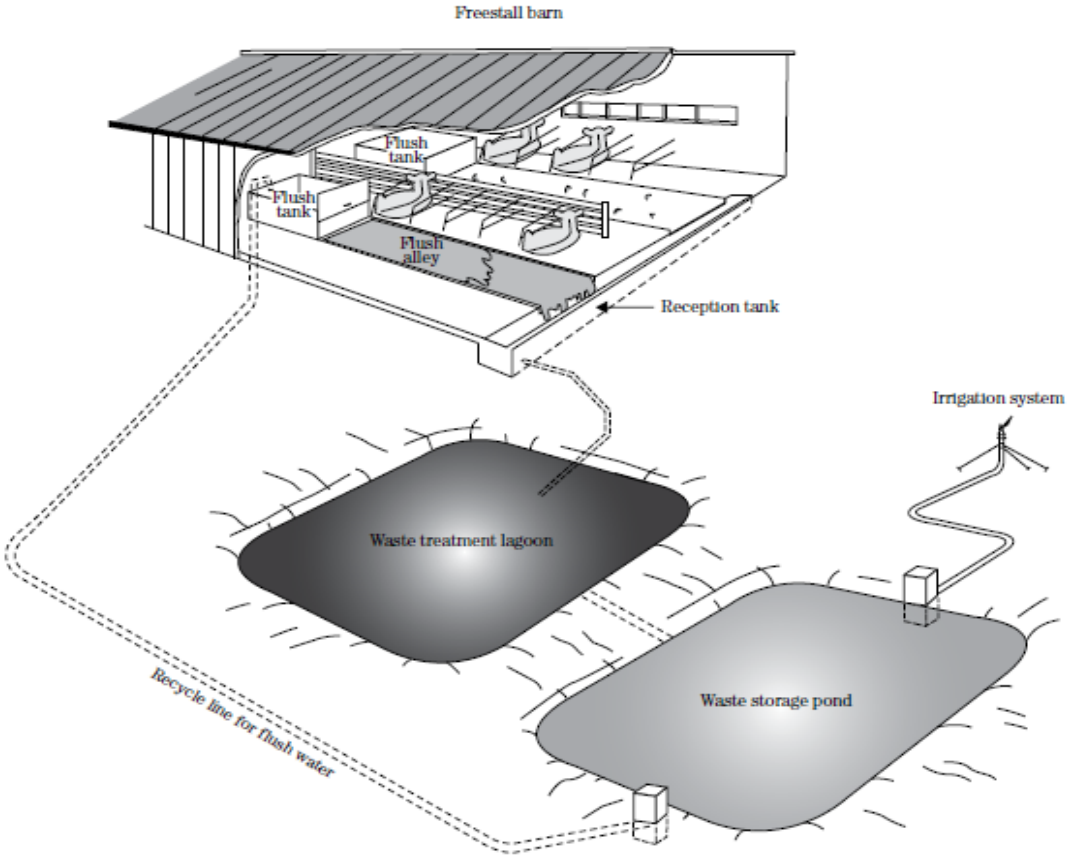


Figure 7: Free stall barn with flushing alleyway and irrigation system

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What ismajor operation for waste managements (4 points)?
2. Write some activities that done in collection operation (4 points)?
3. Write some activities that done in transfer operation (4 points)?

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

1. _____

   _____

2. _____

   _____

3. _____

   _____

Information sheet-3	Flushing and draining in-shed dairy waste pits

3.1. Effluent collection

Washdown hoses, flood washing and scrapers can all beused to move effluent to collection areas. Ultimately all effluent from the yard races, yards, milkingpit and milk storage area should drain to a single,temporary storage point.This point is the effluent sump. There are four areaswithin the farm dairy where effluent is collected:

- the **step barrier** at the yard entrance
- **grate traps** throughout the farm dairy
- the **milking pits**
- effluent and wash water **drains.**

Effluent from all these areas must be directed to the effluent collection facility.Place a step barrier at the end of the race where it meets the yard. The step will catch loose material and flick itoff cows' hooves, reducing stone and soil entry into the yard. A small nib wall (50 mm high) across the end of the racewill help prevent soil and dung from being brought into the yards by the herd. It will also help guide wash water todrains and prevent effluent flow into the farm races and stop stormwater from entering the farm dairy area.Concrete nib walls may be hard on cows' feet, especially while they are getting used to it. Timber is also an option,e.g. half-buried posts or telephone poles can be laid across the yard entry (referFigure 8).

Figure 8: an effective timber poles steps barrier

Grate traps:

should be placed around the yard so that stones can be caught when effluent falls through thegrating into the drains below. It is important that the grating has gaps of no less than 25 mm and that it is easily removable for maintenance (Figure 9). The grating should be flush with the yard concrete socows do not clip their hooves. There can be difficulty in flushing effluent down traps placed in the center of the yard, as there is no backing wall to prevent the effluent running past the trap.Gratings placed across the line of stock traffic can halt cow flow, because of the noise of water passing under the grill, and because cows may consider the grill a physical barrier. Orientate the grate trap so that the grating runs perpendicular to the line of traffic. This will aid cow flow as cows will be less able to perceive the gaps in thegrating. Otherwise, the traps should be placed along the sides of the yard against the nib wall backing. The milking pit collects high volumes of cow dung andwater. Where **milking pits** are built into the ground, and there is a drain provided to carry water and effluent from the pit to the sump, care should be taken toensure that the fall is not too slight. Otherwise the effluent will back flow if the sump is flooded during a storm, or if the sump outlet is blocked. The pit will fill in due course, making milking uncomfortable or impossible until flushing is undertaken.

Figure 9: removable grating

Drains:

To maintain hygiene standards, it is better to pipe or channel effluent rather than to let it flow across open concrete. Drains convey effluent from the farm dairy to the sump, and from the sump to the holding pond or oxidation ponds in the following ways:

- **gravity flow in pipeline**, flowing full or partly full
- **pressure flow in a pipeline** connected to a pump.

Generally, **channel systems** are more cost effective than pipelines.However, problems with maintenance and weed control, channel crossings, and health and safety risks limit the value of channels. Unlined open channels should only be used once solids have been removed from the effluent. Channels should be concrete and constructed withsloping walls. The added expense of concrete is justified due to a more successfully operating channel with a much lower maintenance requirement. Channel drains are available as pre-cast sections and can be installedby the farmer (refer to Figure 10).**Gravity flow pipelines** can be a major cost, especially where large-diameter gravity pipelines are used. Costsavings can be achieved through minimizing the length of the line, and by removing solids from the effluent.Thiswill allow smaller pipes to be used.To obtain cost savings, shop around when purchasing pipe material.The recommended **minimum diameter for gravity flow pipes is 100 mm**.Use sewer class pipes rather thanstormwater class pipes.The fall can be reduced with larger diameter pipes and more liquid effluent.

Figure 10: Precast drain section

Self-Check -3	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. what are four areas that used for collecting dairy effluents (4 points)?
2. _____ be placed around the yard so that stones can be caught when effluent falls through the grating into the drains below (4 points)?
3. _____convey effluent from the farm dairy to the sump, and from the sump to the holding pond or oxidation ponds in the following ways (4 points)?

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

1. _____
   _____
2. _____
   _____
3. _____
   _____

Reference

James E. Hanna Wald Resource Conservationist.1999. Alternative Waste Management Technologies Summary of Available Resources

Andrews, J.E., 1991. "Livestock Waste Management System Planning Flowchart". ASAE Paper No. 912538.The American Society of Agricultural Engineers, Michigan, USA.

Monks, L. and R.Wrigley, 1993.“Managing Dairy Shed Wastes: Volume One”. Dairy Research and Development Corporation, Victoria, Australia.

P. Jacobs & Associates Ltd. Graphic Design Techno Media Inc.: Fisheries, Aquaculture and Environment. *Agricultural Waste Management*

DAIRY PRODUCTION

LEVEL-III

Learning Guide -66

Unit of Competence: - Implement dairy farm waste management

Module Title: - Implementing dairy farm waste management

LG Code: AGR DRP3 M17LO04**-**LG66

TTLM Code: AGR DRP3TTLM1219 -v1

LO4: Monitor dairy waste disposal system

Information sheet	Learning Guide #66

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Checking flow rates, pit levels and equipment
- Carrying out cleaning procedures and hygiene practices

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Observe and follow organizational OHS procedures, practices, policies and precautions, including the use of personal protective equipment.
- Check regularly flow rates, pit levels and equipment to maintain effective operation of the system.
- Carry out cleaning procedures and hygiene practices according to established practice.
- Monitor reflects an understanding of environmental duty of care

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1 and proceed other turn by turn”
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1 and do the same on other self-check of information sheet).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to previous Learning Activity.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information sheet-1	**Checking flow rates, pit levels and equipment**

1.1. Dairy Ponds

Ponds are the conventional method used tostore effluent on dairy farms in Australia. In conjunction with a means of solid separation,a single pond system is normally designed tohold the maximum quantity of waste producedover a designated period. Ponds can bedesigned to be both the solids separationsystem and storage mechanism. This can bedone by trapping floating material behind abarrier and having the inlet-end of the ponddesigned shallow enough for solids removalusing a backhoe or excavator at routineintervals.

1.1.1. Holding Ponds

Pond systems can achieve substantial reductions in the organic polluting potential of effluent. However, it isbecoming more apparent that pond outflow quality may not be acceptable in the light of current environmentalconcerns, particularly regarding ammonia, nutrient and pathogenic micro-organism concentrations.Different rules apply to ponds and surface water discharges in different regions (check with your Regional Councilfor requirements). In some Regions surface water discharges are unacceptable but ponds for storage purposes maystill be built.

1.1.2. Pond sizing

It is far more accurate to use design values, particularly effluent volumes, based on figures from individualproperties than those based on general assumptions. Whencalculating the volume of effluent flowing from the farm dairy into pondsconsider water volumes used for:

- plant rinses
- plant and vat washing
- milk cooling in the plate cooler system
- yard and pit washdown
- washing adjoining facilities (e.g. calf facilities)
- effluent collected from stand-off and feed pad facilities.

I. The anaerobic pond

Anaerobic ponds are deep treatment ponds that exclude oxygen and encourage the growth of bacteria to breakdown the effluent. They should be constructed:

- **to a depth of 3 m to 4 m.**Depths greater than 4 m should be avoided due to limitations of desludgingmachinery
- **with a small surface area.** A small surface area minimizes the area in contact with oxygen at the pond surface,reduces heat loss, encourages mixing, promotes the formation of an undisturbed surface layer and minimizes the surface area to catch rainfall
- **with the long axis perpendicular to the prevailing wind.** This will maximize the settlement of solids. Ifshelter is provided from the wind, the pond may be orientated otherwise.

Table 1: anaerobic pond requirement for properties

Cow numbers	Required volume	At normal effluent depth	Size	Surface area	Top bank size	Pond floor size
100	470 m^3	3.0 m	15 m x 22 m	330 m^2	17 m x 24 m	3 m x 10 m
150	690 m^3	3.0 m	16 m x 28 m	450 m^2	18 m x 30 m	4 m x 16 m
200	910 m^3	3.0 m	17 m x 33 m	560 m^2	21 m x 35 m	5 m x 21 m
250	1130 m^3	3.0 m	19 m x 35 m	670 m^2	21 m x 37 m	7 m x 23 m
300	1400 m^3	4.0 m	21 m x 33 m	690 m^2	23 m x 35 m	5 m x 17 m
350	1620 m^3	4.0 m	21 m x 37 m	780 m^2	23 m x 39 m	5 m x 21 m
400	1840 m^3	4.0 m	21 m x 42 m	880 m^2	23 m x 44 m	5 m x 26 m
450	2050 m^3	4.0 m	21 m x 46 m	970 m^2	23 m x 48 m	5 m x 30 m
500	2270 m^3	4.0 m	21 m x 50 m	1050 m^2	23 m x 52 m	5 m x 34 m

A. Anaerobic pond sizing assumptions

Anaerobic pond design takes into account the **BOD loading, prevailing environmental temperatures** and **localrainfall and evaporation.BOD Loading**The reduction of BOD before discharge into a waterway is a prime concern.Therefore, **the required size of the pond system is based on the BOD5 loading per cow per day.**For a typical grazing system this can be taken as **0.12 kg/cow/day** unless Regional Councilregulations deemotherwise.From the per-cow loading, the total daily herd loading is directly proportional to the number of cows milked. (Notethis does not account for excess effluent collected in places other than the farm dairy e.g. from a feed pad or standoffarea).

The following is an example of this calculation:300 cows are milked on a property situated in Northland. The farmer wishes to install a pond system for effluentdischarge to a waterway.

From the example:

- number of cows = 300
- BOD5 loading per cow per day = 0.12 kg/cow/day

- total BOD5 loading = 300 cows x 0.12 kg/cow/day = 36 kg/day.Prevailing Environmental Temperatures

Prevailing environmental temperatures affect anaerobic processes so pond design must take this intoaccount. In regions where prevailing temperatures are low, the pond system will need to be larger than those in warmerregions.Design criteria for pond systems in these regions are provided in Table2

Table 2: Recommended anaerobic ponds bod_5 loading rate

Region	BOD_5 loading
Northland, Auckland, Waikato, Bay of Plenty, Gisborne and Hawke's Bay	0.028 kg/m^3/day
Manawatu, Wanganui, Taranaki, Wellington, Marlborough, Tasman, Nelson and Canterbury	0.024 kg/m^3/day
West Coast, Otago and Southland	0.020 kg/m^3/day

Using the total BOD5 loading from the herd and the regional BOD5 loading rate, the volume of the anaerobic pondcan be calculated.

From the example:

- total BOD5 loading = 36 kg/day
- Northland region's BOD5 loading rate = 0.028 kg/m3/day
- **anaerobic pond volume required = 36 kg/day ÷ 0.028 kg/m3/day = 1286 m3.**

The regional BOD5 loading rate should not be considered a rigid value, but can be adapted to more closely modelthe situation found on any specific property.

Local Rainfall and Evaporation

Rainwater falling directly into the pond system also has to be accounted for in the loading calculations, particularlyin high rainfall areas. Rainwater volume can be calculated using 'rainfall less evaporation' data, the surface areaexposed to the rainwater and the degree of runoff/entry actually taking place (i.e. off yards 85%, direct rainfall100%).The pond freeboard will absorb some rainfall. However, it is wise to allow for rainfall volumes from thewettest month when designing pond capacity.

From the example:

- rainfall less evaporation for the wettest 30 days

= Aug: 176 mm - 47 mm = 0.129 m

- estimate of anaerobic pond surface area (refer to Table 3.5-2) = 690 m2
- 100% rainfall entry
- rainfall less evaporation

= 0.129 m x 100% x 690 m2 = 89 m3.

Stormwater from the farm dairy and runoff from surrounding land have to be accounted for only if appropriatediversions are not in place (refer to 3.6.3 Stormwater control).

A. Total volume – anaerobic pond

The total volume is calculated as:(BOD5 loading) + (local rainfall less evaporation data), From the example:

- from total BOD5 loading = 1286 m3
- from rainfall less evaporation = 89 m3
- total volume = 1375 m3
- therefore, the anaerobic pond volume will need to be 1375 m3 (refer to Table 3).

B. Anaerobic pond specifications

Design standards can be given for a typical grazing system, but need to be adjusted for intensive systems and feedpad or stand-off areas that are connected to the effluentsystem. In the design standards for pond sizing for atypical grazing dairy system, assume the following:

- a BOD5 loading of 0.12 kg/cow/day
- inclusion of local rainfall and evaporation data.

The following design specifications have been used for anaerobic pond sizing:

- length to width ratio of the anaerobic pond is close to 2: 1
- minimum pond depth is 3 m for ponds serving up to 250 cows. For larger herds, pond depth is 4 m.

Thisis to allow a 2: 1 batter slope to be used with the appropriate pond widthfreeboard is 500 mm for ponds. This will allow for effluent lapping against the pond walls, shock loadingsfrom rainfall or the farm dairy, and any temporary shutdown of the outflow

- internal batter slope is 2 horizontals to 1 vertical (i.e. slope = 2: 1)
- pond width does not exceed 24 m because of the 'reach' limitations of excavator and desludging machinery.

The anaerobic pond sizing requirements given do not apply to effluent storage before land application. If all theeffluent from the ponds is to be applied to land, and none is to flow to a receiving waterway, then the sizing forholding ponds should be used

1.2. The aerobic pond

When sizing aerobic ponds, emphasis must be given to the surface area. Increasing the surface area of theaerobic pond will improve the performance of the system. When orientating the aerobic pond, the long axis should be perpendicular to the prevailing wind. This will maximize the settlement of solids. If shelter is provided from the wind the pond may be orientated otherwise.Two ponds should be used to make up the required aerobic pond surface area rather than having one verylarge aerobic pond. Use two smaller ponds rather than a single large pond if:

- cow numbers in the herd are over 300
- the pond is likely to be too large for effective desludging and stirring
- the pond is too long for the site and interferes with existing structures such as tracks and fences.

In thecase of site restrictions to pond length, two smaller aerobic ponds could be placed side by side.Split the flow from the anaerobic pond to the two aerobic ponds (i.e. have

the aerobic ponds working inparallel). Overloading may occur, and odours may develop, in the first pond if the aerobic ponds are in series.

I. Aerobic pond sizing assumptions

Aerobic pond design takes into account the BOD loading, surface area of the pond and local rainfall andevaporation.

BOD loading: The reduction of BOD before discharge into a waterway is a prime concern. The required size of the aerobicpond is based on the BOD5 loading.The loading into the aerobic pond can be taken as 30% of the BOD5 loading into the anaerobic pond unlessRegional Council regulations deem otherwise (check with your Regional Council for requirements).

From the example:

- total BOD5 loading at the anaerobic pond = 36 kg/day
- total BOD5 loading at the aerobic pond = 30% of 36 kg/day = 10.8 kg/day.

Surface AreaThe most important design feature of aerobic ponds is the surface area. It is this that affects pond systemperformance.The pond system is sized according to BOD5 loading in relation to surface area. The guideline for the aerobic pondloading rate is 120 m2 surface area per 1 kg of BOD5 input unless Regional Council regulations deem otherwise(check with your Regional Council forrequirements).Using the total BOD5 loading into the aerobic pond and the 120 m2 surface area per 1 kg of BOD5 loading rate, thesurface area of the aerobic pond can be calculated.

From the example:

- total BOD5 loading at the aerobic pond = 10.8 kg/day
- **aerobic pond surface area required = 10.8 kg/day x 120 m2/ kg BOD5 = 1296 m2.**

Local rainfall and evaporation:

Rainwater falling directly into the pond system also has to be accounted for in the loading calculations, particularlyin high rainfall areas. The rainwater volume can be calculated using ‘rainfall less evaporation’ data and the surfacearea exposed to the

rainwater and the degree of runoff/entry actually taking place (i.e. off yards 85%, direct rainfall100%).

From the example:

- rainfall less evaporation for the wettest 30 days

= Aug: 176 mm - 47 mm

= 0.129 m

- estimate of pond surface area

= 1296 m2

- 100% rainfall entry
- rainfall less evaporation volume

= 0.129 m x 100% x 1296 m2

= 167 m3

- depth = 1.2 m
- **rainfall less evaporation surface area**

= 167 m3 ÷ 1.2 m

= 139 m2

Stormwater from the farm dairy and runoff from surrounding land have to be accounted for only if appropriatediversions are not in place.

Surface area required for total loading – aerobic pond-The surface area required for total loading is calculated as:

(area for BOD5 Loading) + (area for local rainfall less evaporation data).

From the example:

- surface area for total BOD5 loading = 1296 m2
- rainfall less evaporation = 139 m2
- total surface area = 1435 m2
- therefore, the aerobic pond surface area will need to be 1435 m2.

II. Aerobic pond specifications

The design standards for aerobic pond sizing assume the following:

- a BOD5 loading of 0.12 kg/cow/day

• a 70% reduction of BOD5 in the anaerobic pond

• inclusion of a local 'rainfall less evaporation' data component.

The following design specifications have been used for aerobic pond sizing:

• length to width ratio of the aerobic pond is at least 2: 1

• pond depth is 1.2 m. Do not build aerobic ponds deeper than 1.2 m unless they are mechanically aerated.

• freeboard is 500 mm for all ponds

• internal batter slope is 2 horizontals to 1 vertical (i.e. slope = 2: 1)

• pond width does not exceed 24 m because of the 'reach' limitations of excavator and desludging machinery.

1.2.1. Aerobic pond size

Table 4gives the **'Aerobic pond requirements'** that should be adhered to unless local knowledge is wiselyused to adapt these specifications. It gives suggested dimensions that closely fulfil the criteria given. It is recognized that there are alternative sets of dimensions that can fulfil these criteria.

Table 4: Aerobic pond requirements for properties

Cow numbers	Required volume	At normal effluent depth	Size	Surface area	Top bank size	Pond floor size
100	480 m^3	1.2 m	15 m x 32 m	440 m^2	17 m x 34 m	10 m x 27 m
150	720 m^3	1.2 m	19 m x 38 m	710 m^2	21 m x 40 m	14 m x 34 m
200	950 m^3	1.2 m	22 m x 43 m	950 m^2	24 m x 45 m	17 m x 38 m
250	1190 m^3	1.2 m	22 m x 53 m	1220 m^2	24 m x 55 m	17 m x 48 m
300	*1420 m^3	1.2 m				
350	*1660 m^3	1.2 m				
400	*1900 m^3	1.2 m				
450	*2140 m^3	1.2 m				
500	*2370 m^3	1.2 m				

***** Divide this dimension into two smaller aerobic ponds.

Note 1: Based on BOD = 0.12 kg/cow/day.

Note 2: Includes direct rainfall less evaporation allowance. Assumes stormwater from surrounding land is diverted.

Note 3: Batter slope on interior bank = 2: 1.

Note 4: Freeboard = 500 mm for all herd sizes.

1.3. Principles of Measurement

The preliminary treatment of waste water invariably incorporates measurement of incomingflow to the treatment plant. This flowmeasurement is a critical part of the overalltreatment process, in that control of subsequentstages will depend oncontinuous, accurate flowinformation in order to function correctly anddetermine the following:hydraulic loading on treatment units;treatment unit retention times;solids and Biological Oxygen Demand (BOD). loading;prediction of physical and biologicalperformance of process;prediction of and reaction to shock loads, i.e.,industrial and storrnwater;chemical treatment feed rate settings;control of return rates;calculation of flow to mass ratios;calculation of treatment unit costs, i.e., power,chemicals, labor; andscheduling of maintenance.Operational Control in the modern treatment plantwill require automatic and often remoteadjustments to be made between balancing tanks,storm tanks, flow to full treatment and chemicaltreatment, as well as the activation of automaticsampling and alarm systems. These actions andcontrols will be initiated by the incoming flowmeasurement device and will therefore bedependent on its continued accuracy andreliability

1.3.1. Principles of Flow Measurement

Flow can be measured either as a volumetricquantity or an instantaneous velocity (which isnormally translated into flow rate). Fig. 1 demonstrates the relationship and interdependence of these measurements can beseen. They are defined as follows:

- Flow Rate = Velocity x Area (rn/s x rn2 = m3/s).
- Quantity = Flow Rate x Time (rn3/s x s = rn3).

If the flow rate is recorded for a period of time,then the quantity of the flow (i.e. m3) is equal tothe area under the curve as shown on Figure 1 (shaded area). This is often automaticallycalculated and displayed by the measuringinstrument. This value gives the total cumulativevolume entering the works.Other factors which are taken into account in

thederivation of theoretical flow rate formulaeequations are:type of flow IL streamline& turbulent(Reynolds Number) I;energy of liquid[potential/kinetic/pressure/internal];density of liquid;viscosity of liquid; andtemperature of liquid.In practice, the above factors are taken intoaccount by the use of a Discharge Co-efficient(C), which is a measure of the actual volumeflowing through a device divided by thetheoretical volume flowing. This together withthe measurement of heads or pressures, (H1, H2 orP1, P2), areas (a) and forces of gravity (g), areused in practical flow formulae for the calculationof actual flows.FLOW

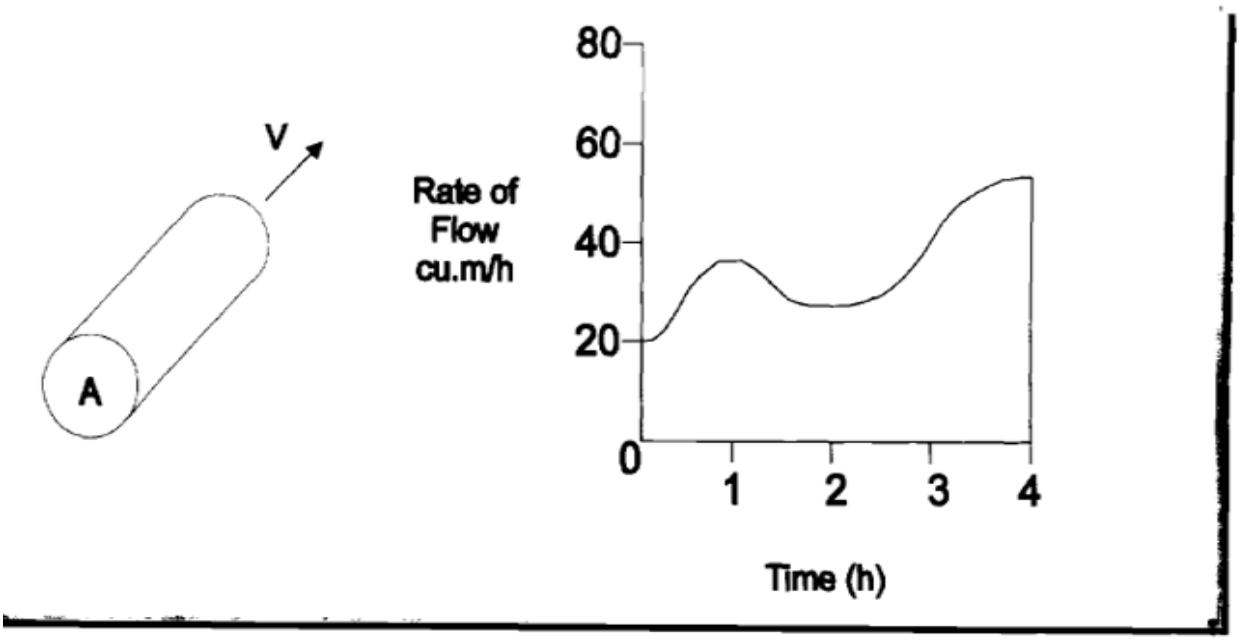


Figure 1: flow -time graph

1.4. Receiving waterway flow rates

Discharges into small and slow-flowing waterways may have a larger impact due to the waterway's limited capacity to dilute and assimilate effluent. Minimum receiving water flow rates for some typical dilutions are given in Table 3. Regional Councils generally set site-specific conditions for assimilation of ammonia. These will not generally be below 100 times dilution (i.e. 100 litres of natural water to 1 litre of discharged effluent).

250 times dilution provides a higher degree of environmental protection from ammonia toxicity, necessary where sensitive fish populations are present.

Table 3: minimum receiving water flow rate

	Peak discharge[2]	Constant discharge[3]	Peak discharge[2]	Constant discharge[3]
100	35 l/s	17 l/s	90 l/s	45 l/s
150	50 l/s	25 l/s	125 l/s	62 l/s
200	70 l/s	35 l/s	175 l/s	87 l/s
250	90 l/s	45 l/s	225 l/s	112 l/s
300	105 l/s	52 l/s	260 l/s	130 l/s
350	120 l/s	60 l/s	300 l/s	150 l/s
400	140 l/s	70 l/s	350 l/s	175 l/s
450	160 l/s	80 l/s	400 l/s	200 l/s
500	175 l/s	87 l/s	440 l/s	225 l/s

Note 1: Based on 50 l per cow per day (i.e. 25 litres per cow per milking).

Note 2: Assumed discharge running from the last hour of milking and 3 hours after washdown. Receiving water flow rates based on a 2-hour peak loading during this four-hour period.

Note 3: Receiving water flow rates can be **halved** if a constant discharge (rather than a fluctuating and peak discharge) is maintained from the pond system into the waterway over the 4 hours.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is difference between aerobic and an aerobic pond (4 points)?
2. Way we consider rain water during constructing waste pond (4 points)?
3. What is flow rate (4 points)?

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

1. _____

_____

2. _____

_____

3. _____

_____

Information sheet-2	Carrying out cleaning procedures and hygiene practices

2.1. Good Hygiene Practices Cleaning

2.1.1. The principles of cleaning

Cleaning means to eliminate visible dirt deposits of which there are two types:

- Organic deposits such as fat, protein, lactose as far as milk deposits are concerned
- Mineral deposits such as limescale or milk stone which is a mixture of milk fats, protein, lactose and limescale)

In cheese production, thorough cleaning without disinfection is better than systematic disinfection of equipment and materials in order to preserve the natural flora and the balance of the microbial ecosystem. The use of disinfection is a decision for the professional cheesemaker.

I. Choice of detergents (cleaning products)

A detergent used in an aqueous solution helps to remove deposits (soiling) from surfaces and trap them as a suspension in the cleaning fluid. Several types of detergent exist:

- **Alkaline detergents** which remove organic materials

- **Neutral detergents** which are products for manual cleaning and must not be harmful to the skin.
- **Acid detergents** which remove mineral deposits such as limescale and milk stone.
- **Enzymatic detergents** which contain enzymes that are designed to remove a specific substrate and which constitute a possible alternative to alkaline detergents.

Other additives may be present in the product, to help in the detachment of different types of soiling which may depend on the surfaces to be treated. Examples include:

- **Wetting agents (surfactants)** neutralize surface tension and enable better contact with the deposits,
- **Chelating agents** limit the formation of limescale,
- **Foaming agents** enable the cleaning solution to be applied as a foam which can increase the contact time
- **Disinfectants** such as chlorinated alkali or peracetic acid can be combined with a detergent.

Do not mix an alkaline cleaning product with an acidic product because this neutralizes their effectiveness.

In cases where preservation of the natural microflora in the environment is desirable and the products manufactured comply with EU legislation, it may be possible to clean production equipment by rinsing only with water at a defined frequency.

All cleaning chemicals must be suitable for use in the food industry and compliant with current EU legislation. When choosing cleaning products, it is important to consider:

- The type of soiling or deposit: an alkaline detergent should be selected for organic deposits or acidic detergents for mineral deposits.
- The type of surface: chemicals should not corrode the surface to which they are applied.

Equipment constructed from stainless steel or food-safe plastic has the highest resistance to cleaning products and disinfectants whereas cookware categoryaluminium and aluminium alloy (almasilium) do not tolerate alkaline chemicals well. Avoid using cracked, scratched or pitted equipment as it is hard to clean. Cleaning products that contain hypochlorite (bleach) are not recommended for aluminium surfaces and should be used only with cold water to avoid inactivation of the disinfectant. It is not recommended to soak stainless steel in hypochlorite.

II. Good Hygiene Practices Cleaning

Hardness of water: the efficacy of detergents depends on the hardness of the water used for cleaning. Very hard water can reduce the efficacy of the detergent which can necessitate the addition of chelating agents. The frequency of acidic cleaning must take into account the hardness of the water, the condition of the surface and the process for which the equipment is used. More acid must be used with older equipment which is harder to clean while equipment that becomes hot in use is more prone to milkstone deposits than equipment that is used when cold.

- The cleaning method (eg. automatic or manual) - being careful to achieve a scrubbing action on the equipment surfaces.

Clean with "TACT"

When a detergent is used, it is necessary to define and apply the following parameters:

- **Time T**he chemical should be in contact with the surface for sufficient time.
- **Action** The mechanical effects of turbulence, scraping or scrubbing actions must be sufficiently vigorous to detach the deposits from the surface,
- **Concentration** Chemical dose must be sufficient to ensure its efficacy,
- **Temperature** Cleaning solution must be used at an appropriate temperature and in accordance with the manufacturer's instructions.

For all these factors, follow the recommendations on the cleaning product labels. Ensure to respect temperature recommendation according to the equipment and practices used. It is recommended, particularly when establishing procedures, to fully

check the parameters used for cleaning such as temperature, dose, time and quantity of rinse water.

Cleaning equipment to be used:

- To avoid damaging equipment during cleaning and to avoid encouraging the development of undesirable germs: abrasive scouring pads that scratch the material should not be used. Sponges and cloths can remain damp or wet after use and thereby encourage the development of germs. Rather, use scrubbing brushes or scrapers with a plastic handle and edges or bristles made of nylon for small equipment in cheese production areas or the external parts of milking equipment.
- In order to avoid spraying dirty water on the products or the equipment during cleaning, avoid the use of high-pressure sprays in premises where dairy products are present and rinse preferably with cold water to avoid condensation.

Water quality: Refer to the recommendations of chapter GHP Water quality.

Protocol for cleaning: Cleaning includes the following stages:

In case where preservation of the natural microflora in the environment is desirable and the products manufactured comply with EU legislation. Particular care must be taken to provide sufficiently hot water and ensure sufficient mechanical action and contact time.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is principle of cleaning (4 points)?
2. What is protocol for cleaning (4 points)?
3. What mean Good Hygiene Practices Cleaning (4 points)?

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

1. _____

_____

2. _____

_____

3. _____

_____

Operation Sheet-1	Carrying out cleaning procedures and hygiene practices

1. The cleaning dairy equipment after you disposing dairy waste :

Steps 1: Recovery of product residues by scraping, drainage and expulsion with water or compressed air

Steps 2: Pre-rinsing with water to remove loose dirt

Steps 3: Cleaning with detergent

Steps 4: Rinsing with clean water

Steps 5: Disinfection by heating or with chemical agents (optional); if this step is included, the cycle ends with a final rinse, if the water quality is good.

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within

Reference

United States Department of Agriculture Natural Resources Conservation Service. 2011. Agricultural Waste Management Field Handbook

Oklahoma Cooperative Extension Fact Sheets are **also available on our website at:** http://osufacts.okstate.edu

Dr. David Douphrate, PhD, MPT, MBA, CPE, CSP University of Texas School of Public Health (NIOSH Ag Center Affiliation: High Plains and Intermountain Center for Agricultural Health and Safety; and Southwest Center for Agricultural Health, Injury Prevention and Education)

Randolph Weigel Project Director – Wyoming AgrAbility University of Wyoming Extension.2012. Personal Protective Equipment for Agriculture.

DAIRY PRODUCTION

LEVEL-III

Learning Guide -67

Unit of Competence: - Implement dairy farm waste management

Module Title: - Implementing dairy farm waste management

LG Code: AGR DRP3 M17LO05-LG67

TTLM Code: AGR DRP3TTLM1219 -v1

LO5:Conduct hygiene and administration activities

Information sheet	Learning Guide #67

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Cleaning equipment
- Cleaning and storing attachments and other ancillary equipment.
- Disposing all containers, leftover fluids, waste and debris from the operations

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to –**

- Clean equipment in accordance with manufacturer's specifications, organizational procedures and regulations.
- Clean and store attachments and other ancillary equipment in accordance with manufacturer's specifications, organizational procedures and regulations.

- Dispose safely and appropriately all containers, leftover fluids, waste and debris from the operations
- Complete accurately and promptly all required records and documentation in accordance with organizational requirements.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1 and proceed other turn by turn”
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1 and do the same on other self-check of information sheet).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to previous Learning Activity.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information sheet-1	Cleaning equipment

1.1. Cleaning Objectives

Talking about cleaning results, the following terms are used to define the degree of cleanliness:

- Physical cleanliness – removal of all visible dirt from the surface
- Chemical cleanliness – removal not only of all visible dirt but also of microscopic residues that can be detected by taste or smell but are not visible to the naked eye
- Bacteriological cleanliness – attained by disinfection
- Sterile cleanliness – destruction of all microorganisms

It is important to note that equipment can be bacteriologically clean without necessarily being physically or chemically clean. However, it is easier to achieve bacteriological cleanliness as a matter of routine if the surfaces in question are firstrendered at least physically clean.In dairy cleaning operations, the objective is nearly always to achieve

both chemical and bacteriological cleanliness. The equipment surfaces are therefore first thoroughly cleaned with chemical detergents and then disinfected.

1.2. Cleaning Procedures

Cleaning of dairy equipment was formerly done (and still is in some places) by people armed with brushes and detergent solutions, who had to dismantle equipment and enter tanks to get to the surfaces. This was not only laborious but alsoineffective; products were often reinfected from imperfectly cleaned equipment.Circulatory cleaning-in-place (CIP) systems adapted to the various parts of a processing plant have been developed to achieve good cleaning and sanitation results.Cleaning operations must be performed strictly according to a carefully worked out procedure in order to attain the required degree of cleanliness. This means that the sequence must be exactly the same every time.The cleaning cycle in a dairy comprises the following stages:

- Recovery of product residues by scraping, drainage and expulsion with water or compressed air
- Pre-rinsing with water to remove loose dirt
- Cleaning with detergent
- Rinsing with clean water

Disinfection by heating or with chemical agents (optional); if this step is included, the cycle ends with a final rinse, if the water quality is good.

Different approaches:

1. Foam cleaning
2. Manual cleaning
3. COP
4. CIP

1. Foam cleaning

Wetter foam generally better than dry foam

- Define a start point and an end point
- No advantage to using hot water for foam
- Do not allow foam to dry
- Foam undersides of equipment

- Scrub as necessary to remove film, fats, and proteins
- Clean drains with dedicated tools & PPE

2. Manual Cleaning

Manually scrubbing may be required to remove heavy soils

- Use color-coded, single-use pads and brushes as required
- Do not place parts on the floor
- Use a cart, table or mat for parts placement

3. Clean Out of Place (COP) Tanks

Automatic equipment parts washing

- Thorough pre-rinse required
- Be sure all parts are adequately covered
- Test kit verification of concentration
- Control cleaning solution temperature to melt fats
- Separate rinse and sanitize steps

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is cleaning objective (4 points)?
2. Write cleaning procedure (4 points)?
3. What is manual cleaning (4 points)?

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

1. _____
   _____
2. _____
   _____
3. _____
   _____

Information sheet-2	Cleaning and storing attachments and other ancillary equipment.

What is ancillary device?

Ancillary Equipment means any device used to distribute, dispense, meter, monitor, or control the flow of regulated substances to and from an UST system.

2.1. Cleaning Equipment

When it comes to cleaning tillers, combines, hay balers, livestock trailers, trucks, tractors, and everything else that gets exceptionally dirty, you want to get the job done quickly and easily. You spend enough time and energy farming, so the less effort you have to put into cleaning the better.

Hot water pressure washers make it quicker and easier to clean dirt, grease, manure, and oil splatter. Steam capable hot

water pressure washers are even better at cleaning effectively and efficiently. They use less water and require less time to loosen tough dirt and stains. With the attachable wands and accessories available today, you hardly have to bend to reach the most inaccessible areas. You can even reach high places without a ladder, so if you'd like to clean your barn or the second story of your house, use a telescoping wand.

Furthermore, cleaning every crevice can help you detect problems with your machinery early. This means addressing the problem sooner and preventing further problems from developing. Finding a leak in your oil pan may not be the greatest news, but not finding it and having to replace the entire piece of equipment is much more costly. Furthermore, keeping your machinery clean will help prevent rust and corrosion, extending the lifespan of the machinery you've invested so much into.

When pressure washing agricultural machinery, be sure you're at least 100 feet from the wellhead of your well to prevent contamination. Also make sure to pressure wash over an unpaved surface so runoff filters through the soil and recharges the groundwater. Agricultural equipment isn't cheap. However, if you clean it more frequently, it'll last longer and perform better. The longer it lasts, the more you save, and the better off you and your family will be.

2.2. **Equipment Maintenance and Cleaning**

Schedules and procedures (including assignment of responsibility) should be established for the preventative maintenance of equipment.Written procedures should be established for cleaning equipment and its subsequent release for use in the manufacture of intermediates and APIs. Cleaning procedures should contain sufficient details to enable operators to clean each type of equipment in a reproducible and effective manner. These procedures should include:

1. Assignment of responsibility for cleaning of equipment
2. Cleaning schedules, including, where appropriate, sanitizing schedules

3. A complete description of the methods and materials, including dilution of cleaning agents used to clean equipment
4. When appropriate, instructions for disassembling and reassembling each article of equipment to ensure proper cleaning
5. Instructions for the removal or obliteration of previous batch identification
6. Instructions for the protection of clean equipment from contamination prior to use
7. Inspection of equipment for cleanliness immediately before use, if practical
8. Establishing the maximum time that may elapse between the completion of processing and equipment cleaning, when appropriate

Equipment and utensils should be cleaned, stored, and, where appropriate, sanitized or sterilized to prevent contamination or carry-over of a material that would alter the quality of the intermediate or API beyond the official or other established specifications.

Where equipment is assigned to continuous production or campaign production of successive batches of the same intermediate or API, equipment should be cleaned at appropriate intervals to prevent build-up and carry-over of contaminants (e.g.,degradants or objectionable levels of microorganisms).

Nondedicated equipment should be cleaned between production of different materials to prevent cross-contamination.Acceptance criteria for residues and the choice of cleaning procedures and cleaning agents should be defined and justified.Equipment should be identified as to its contents and its cleanliness status by appropriate means.

2.2.1. **Calibration**

Control, weighing, measuring, monitoring, and testing equipment critical for ensuring the quality of intermediates or APIs should be calibrated according to written procedures and an established schedule.Equipment calibrations should be performed using standards traceable to certified standards, if they exist.Records of these calibrations should be maintained.The current calibration status of critical equipment should be

known and verifiable.Instruments that do not meet calibration criteria should not be used.

Deviations from approved standards of calibration on critical instruments should be investigated to determine if these could have had an effect on the quality of the intermediate(s) or API(s) manufactured using this equipment since the last successful calibration.

Self-Check -2	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

4. What is ancillary equipment cleaning (4 points)?
5. Why we calibrate equipment (4 points)?

Note: **Satisfactory rating –8 points** **Unsatisfactory - below 8 points**

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

1. _____
   _____
2. _____
   _____

Information sheet-3	**Disposing all containers, leftover fluids, waste and debris from the operations.**

3.1. Waste Disposal

What is the one thing we hate seeing on the roads? It's waste, right? People throw away waste everywhere without thinking. But do you know that it can lead to epidemics? Waste disposal is essential for the sanitation of a city and health of the citizens. Let's study how we can dispose of waste in a safer manner.

3.2. What is Garbage?

All the waste we generate in the form of fruit and vegetable peels, leftover food,packing material, old and unwanted plastic objects, old clothes, etc. is the 'garbage'.

3.3. Dealing with the Garbage

Garbage may have these components:

- Useful components or products which we can reuse or recycle.
- Components which we can neither recycle nor reuse and are useless components of the garbage.

While dealing with the garbage, it is important to separate the useful part of the garbage. Also, it is very important to dump the non-useful part in such a way that it does not harm the people or the surroundings. Let's learn about some of the methods of waste disposal.

3.4. Methods of Waste Disposal

1**. Composting and Vermicomposting**

This method is useful for the disposal of biodegradable waste. The part of the garbage which can rot in nature to form harmless substances is called biodegradable (plants and animal waste). Different biodegradable waste can be dumped in a pit. Here, it can be allowed to decompose after which the garbage will convert into useful manure. This is known as composting.The process of decomposition may take around 2 to 3 months. To make the process fast, red worms may be used for composting. This method is called vermicomposting. Vermicompost is the high-quality manure.

Advantages of Composting

- The useful component of the garbage can be converted into manures which can enrich the soil.
- Degradable waste is easily disposed of.

2. Landfilling

A low-lying open area out of the city where garbage is collected and dumped is known as a landfill. The garbage is loaded into the truck and dumped in the landfill. When that area

is fully covered with the garbage, it is covered with layers of soil. Now it can be converted into a park or a playground.

Advantages of Land-filling

- It is an easy method of waste disposal.

Disadvantages of Land-filling

- Garbage remains open for a long period of time. This can attract flies and cause various diseases.

3. Incineration

This method is mainly used to dispose of the medical waste. In this method, garbage is burnt at a high temperature in a special furnace called Incinerator. This reduces large amounts of garbage into a small amount of ash which can be disposed of in the landfill site.

Advantages of Incineration

- It is the most suitable waste disposal method to dispose of the medical and contaminated waste.

Disadvantages of Incineration

- Energy is used for burning which makes the method costly.
- It may lead to air pollution.

3R Rule for Waste Disposal

Reduce

With individual efforts, we can reduce the waste we produce in the first place. For example; materials must be bought from the market only if it is necessary for us.We can use the same thing again and again for different purposes. For example-

- We can use plastic jars of jams, pickles, oil, etc. for storing things like salt, spices, sugar etc.
- Old invitation cards can be reused to make envelopes.

Recycle

We can reform glass, plastic, metal and paper objects and convert them into useful substances. This process is recycling. For example,

- We can recycle old newspapers, magazines, books, notebooks to make new paper or cardboard.
- Broken or discarded plastic items can be melted and remoulded to form other useful substances.

Self-Check -3	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is garbage (4 points)?
2. What are 3R Rule for Waste Disposal (4 points)?

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

Score = _____

Rating: _____

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

1. _____

   _____

2. _____

   _____

Operation Sheet-1	Foam cleaning

1. Clean dairy waste equipment

steps 1: Define a start point and an end point

steps 2: No advantage to using hot water for foam

steps 3: Do not allow foam to dry

steps 4: Foam undersides of equipment

steps 5: Scrub as necessary to remove film, fats, and proteins

steps 6: Clean drains with dedicated tools & PPE

Operation Sheet-2	Disposing leftover fluids, waste and debris

1. Composting derbies that come from during operation Procedure:

Step 1. Start with a 4 to 6-inch layer of derbies material set on the bottom of the composter or on top of the soil.

Step 2. Add a 3 to 4-inch layer of low carbon material.

Step 3. Add a 4 to 6-inch layer of high carbon material.

Step 4. Add a 1-inch layer of garden soil or finished compost.

Step 5. Mix the layers of high carbon material, low carbon material, and soil or compost.

Step 6: Repeat steps 2 through 5 until the composting bin is filled (maximum 4 feet in height). Cap with dry material

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within

Task 1- Foam cleaning

Task 2-Disposing leftover fluids, waste and debris

Reference

webinar food protection international association. 2017. Cleaning, sanitizing and the seven steps of sanitation

https://dairyprocessinghandbook.tetrapak.com/chapter/cleaning-dairy-equipment

https://www2.health.vic.gov.au › public-health › infection-control-guidelines

www.euro.who.int › __data › assets › pdf_file › Safe-management-of-wastes.

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