Horticultural Crops Production

Level II

Learning Guide-32

Unit of Competence:- Collect Raw Materials for Composting

Module Title:- Collecting Raw Materials for Composting

LG Code: AGR HCP2 M09 LO1-LG-32

TTLM Code: AGR HCP2 TTLM 0120v1

LO1: Identify raw materials

Instruction Sheet	Learning Guide 32

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

- Confirming acceptance criteria and receival procedures of raw materials
- Comparing the characteristics raw materials by handling risk and contaminants
- Identifying potential purpose and assessing acceptance criteria of raw materials
- Selecting appropriate hand tools
- Identifying occupational health and safety hazards
- Selecting suitable personal protective equipment (PPE)

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 –

- Confirm acceptance critera and receival procedures of raw materials
- Compare the characteristics raw materials by handling risk and contaminants
- Identify raw materials for potential purpose
- Select appropriate hand tools
- Identify occupational health and safety hazards
- Select suitable personal protective equipment

Learning Instructions:

1. Read the specific objectives of this learning guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, 2,3,4,5 and 6”.
4. Accomplish the “Self-check 1, 2,3,4,5, and 6” in page -6, 12,27,29,32 and 35 respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1,2 and 3” in page -36, 37 and 38 respectively.
6. Do the “LAP test” in page – 39 (if you are ready).

Information Sheet-1	Confirming acceptance criteria and receival procedures of raw materials

1.1. Definition:

Raw materials: are commonly used as raw materials for compost production which includes crop residuals, dairy waste, food organics such as, food waste, kitchen waste, food processing waste, forestry residuals, manures, plant materials such as, garden organics, green organics, green waste, yard waste, sewage facility grit and screenings, wood and timber, other organic waste or by-product of processing.

Compost: is abiological process (hygienic transformation of organic wastes in a homogeneous and plant available material), that occurs under aerobic conditions (presence of oxygen), with adequate moisture and temperature. Composting can be interpreted as the sum of complex metabolic processes performed by different microorganisms that in the presence of oxygen, nitrogen (N) and carbon (C) available to produce their own biomass. Decomposition phase which involves all the three stages (mesophile, thermophile and cooling) in which breaking both simple and complex organic matter occurs; & Humification phase which corresponds to the maturation phase characterized by the reorganization of the organic matter in stable molecules. For the mesophile stage, the pile temperature slowly increases from ambient temperature to reach the average temperature of this stage, which is about 40 °C. The pH decreases due to the organic acids released from the carbohydrates and lipids degraded by microorganisms. Starting from 40 °C, mesophile microorganisms are gradually replaced by thermophile microorganisms (bacteria, fungi and actinomycetes). The thermophile stage is characterized by a temperature usually between 50 and 60 °C. This stage involves many thermo-tolerant and thermophilic fungi, pH rises because the microorganisms degrade proteins and release ammonia. Above 60 °C, the degradation of organic matter slow down, and after 70 °C, only the enzymes released in the previous stage,

still contribute to the degradation. During cooling stage, the material tends to stability, and the mesophile organisms are re-established. The maturation is carried out at ambient temperature, under the mesophilic microorganisms (bacteria and fungi). Micro and macro fauna appear in

this phase. Antagonism and predation relationships develop between organisms. Antibiotics are synthesized in appreciable quantities. Finally, the release of heat and the weight loss remains low.

Composting: is the practice of creating humus – like organic material outside the soil by mixing, pilling, or otherwise storing organic materials under conditions conducive to aerobic decomposition and nutrient conservation.

Purpose:- To enhance soil fertility status and to increase crop production, at least with minimum cost and without using sophisticated technology.

Figure:1.1 compost/humus

1.2. Confirming acceptance criteria

Specifications for raw materials characteristics and acceptability criteria for receivable are documented for incorporation into supply contract.

- Raw materials which are easily degradable are selected.

  These are:

  - Fruit and vegetable peelings
  - Wood fire ash
  - Paper and cardboard

- House and compound sweepings
- Crop residues (the remainder of a crop after it has been harvested)
- Dead leaves
- Crops grown specifically for the compost heap
- Weeds
- Urine (animal and human)
- Soil

❖ Supply contracts are negotiated and secured on suitable trading terms according to enterprise practice. The following criteria's should be taken into consideration:-

- Rate of decomposition
- Allelopathic effect of the materials
- C:N ratio
- Feasibility

1.3. Receival procedures

The following procedures should be beard in mind during receiving raw materials:

- Raw materials are accurately identified
- Raw materials assessed against specified acceptance criteria.
- Unacceptable materials are rejected according to enterprise procedures.
- Non-conformances are documented and reported according to supervisor procedures.
- Acceptable raw materials are measured
- Quantity is recorded according to supervisor procedures.
- Fee is calculated based on raw material type and quantity, and charged to customer according to supervisor procedures.
- Correct fee payment is received and recorded, and receipt is provided according to supervisor procedures.

Self-Check 1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. What is composting?(2points)
2. List receival procedures of raw materials?(2points)
3. List confirming acceptance criteria?(2points)

Note: Satisfactory rating – 6 points Unsatisfactory – below 6 points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-2	Comparing the characteristics of raw materials by handling risk and contaminants

2.1. Handling risk of compost raw materials

Definition

Contaminant: is an element, compound, substance, or organismis, through its presence or concentration, causes an adverse effect on the compost, nature of an environment or impairs human use of the environment.

Contamination: is any introduction in to compost or in to the environment (water, air, or soil) of micro-organisms, chemicals, waste, or waste-water,in aconcentration that makes the environment unfit for its intended use.

In preparation of compost raw materials worker face so many hazards like:-

- Contamination by different kinds of disease causing organisms.
- Raw materials preparations areas are the home of different kind's organisms that affect humans like snakes
- Different kinds of chemicals may be released due to different chemical process under taken in compost preparation.
- Primary human pathogens: including viruses, mycoplasmas, bacteria, fungi, and cysts or eggs of intestinal parasites, found primarily in disposable diapers and tissues and household medical wastes.
- Secondary pathogens and their toxins: e.g., spores and endotoxins generated by bacterial and fungal growth within the composting process itself.
- Volatile and semi-volatile organic chemicals of both synthetic and natural origin (including noxious odors).
- Persistent, lipophilic organic chemicals.
- Metals, other inorganic materials (e.g., asbestos), and organometallics.
- Allergens from household and yard wastes.
- Corrosive, caustic, explosive and sharp materials.

2.2. Contaminants of compost raw materials

Contamination of ground water supplies can be minimized by storing animal manure on a cement floor or in special holes lined with clay. Rainfall on manure piles can result in a run-off containing pathogenic bacteria that can contaminate the fields, equipment, etc. Therefore, manure piles should be covered with plastic or other materials and/or stored properly. In a similar way, personnel handling manure should not enter the growing fields without paying attention to personal hygiene.

Treated manure should be kept covered and away from waste and garbage to prevent recontamination by birds or rodents. It should be stored well away from the growing fields and separated from product packaging material, so it will not contaminate the fresh produce, water sources or packaged products.

Properly-treated organic fertilizer should be applied prior to planting or during the early stages of plant growth. It should be applied near the roots and covered with soil. Organic fertilizers should not be used when the fruit or vegetable is nearing maturity or harvest. In assessing the severity of the risk of biological contamination, the type of fruit or Vegetable that is being produced should be taken into account. Produce that grows in or on the surface of the soil is more susceptible to contamination, while that growing close to the ground is more likely to be contaminated by splashing during rain or irrigation.

The raw materials of compost may be contaminated by:

- ✓ Pathogens
- ✓ Heavy metals
- ✓ Toxic organic substances

❖ Pathogens

Solid waste may be highly contaminated with human pathogenic micro-organisms, whether or not it has been deliberately mixed with sewage sludge or night soil. Solid disposable baby napkins, disposable paper handkerchiefs and faecal matter from pets are some sources that can give raw solid waste an almost as high bacterial count as sewage sludge. There are two groups of micro organisms that may cause disease: primary and secondary pathogens.

Primary pathogens: which are normally present in raw waste and can cause infections in healthy individuals, include bacteria, viruses, protozoa and helminths eggs. Most of the infections they cause, such as diarrhoea and dysentery, are spread via faecal-oral transmission routes.

Secondary pathogens: are micro-organisms, fungi and acid-producing bacteria, that grow during biological decomposition. These pathogens are less important, but they can cause primary infections and respiratory diseases usually in people with a weak immune system. Composting is an efficient process for killing micro-organisms if it is carried out properly. If the temperature of a composting mass does not exceed 55 C throughout the process, there is serious danger that human and animal pathogens and parasite spores and eggs may survive. The second most important control is time. Bacteria are killed by a combination of temperature and time.

- **Heavy metals**

Heavy metals are found throughout the environment. Soils, plants and water contain various (low) amounts of heavy metals, depending on geological sources and atmospheric deposition. Compost may have an hazardous heavy metal content. Application of compost on a plot of land may cause an increase in the concentration of heavy metals in the soil. Metals of importance are mercury (Hg), cadmium (Cd), copper (Cu) and zinc (Zn), as well as borates (B). Mercury appears in batteries, but also in hospital waste. Cadmium is widely used in paints and plastics. Copper and zinc are used in pigments and dyes and can be released by corrosion of metals. Borates are used in adhesives of paper board. Copper and zinc are essential elements for plant grow and compost can be an important source of these elements for certain crops. In excess, however, the soluble salts are toxic and inhibit plant growth. Borates are toxic to certain plants, especially in arid regions. They are very soluble and leach out by rainfall. Cadmium and mercury serve no traditional role in plant growth

- **Toxic organic substances**

Toxic organic substances, such as pesticides and polycyclic aromatic hydrocarbons, are of minor concern in compost derived from domestic waste. Translocation of these substances

from the root systems to the edible portions of plants may occur to a small extent, and direct contamination by dust from the applied compost will also occur. The contributions via polluted air from all forms of combustion greatly exceed the amount of toxic organic substances which could come from compost. Persistent organic material, such as pesticides and polychlorinated bi-phenyls in compost, could under certain circumstances cause problems, because they have the potential to bio-accumulate in the food chains.

❖ **Untreated animal manure**

The application of untreated animal manure (without composting) during the cultivation period is not recommended because the risk of contamination is greater compared to treated manure. Although raw manure is never recommended as a fertilizer, it is still used in some regions. Where that occurs, the manure should be introduced into the ground during soil preparation and prior to planting. Microorganisms in the soil may reduce the survival of pathogens in the manure; however, time is a critical factor. The manure should be incorporated into the soil and the ground turned periodically to facilitate pathogen reduction. Maximum time should be allowed between the application of manure and planting. The survival period for pathogenic bacteria in manure is unknown, but some researchers estimate that, depending on environmental conditions, it can extend to a year or more.

❖ **Rwa materials not used for compost making**

- ✓ Eucalyptus,
- ✓ fuel (kerosene, diesel, petrol), engine oil & stones
- ✓ pieces of iron, broken glass& plastic materials
- ✓ Any pieces of clothes
- ✓ Hyena cat and dog droppings
- ✓ Crops treated by chemical pesticides(up to 6 months)
- ✓ Avoid use of torn or spin trees branches leaves
- ✓ Any type of wax, any type of fat, hide/skin & etc.
- ✓ Weed seed

2.3. Work place inspections

❖ **General requirement**

Every employer must ensure that regular inspections are made of all workplaces, including buildings, structures, grounds, excavations, tools, equipment, machinery and work methods and practices, at intervals that will prevent the development of unsafe working conditions. Unsafe or harmful conditions found in the course of an inspection must be remedied without delay.

❖ **Reporting unsafe conditions**

Whenever a person observes what appears to be an unsafe or harmful condition or act the person must report it as soon as possible to a supervisor or to the employer, and the person receiving the report must investigate the reported unsafe condition or act and must ensure that any necessary corrective action is taken without delay.

❖ **Emergency circumstances**

If emergency action is required to correct a condition which constitutes an immediate threat to workers only those qualified and properly instructed workers necessary to correct the unsafe condition may be exposed to the hazard, and every possible effort must be made to control the hazard while this is being done.

Treatments to reduce the risks

To convert organic waste into a safe fertilizer (compost), 'Good Manufacturing Practices' should be followed to reduce the presence of pathogenic bacteria. Composting is a natural, biological process by which organic material is decomposed. Bacteria and fungi that ferment the organic material and reduce it to stable humus carry out the composting process. Because the fermentation process generates much heat, it reduces or even eliminates biological hazards.

Self-Check 2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. Potential risk compost for workers?(3points)
2. Discuss primary and secondary raw materials contaminants?(3points)
3. Discuss how to treat compost raw materials?(3points)

Note: Satisfactory rating – 9 points Unsatisfactory – 9 below points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-3	Identifing raw materials for potential purpose

3.1. Characterizing raw materials

In general, any type of organic material of plants and animals can be used. It is essential to mix old and tough materials, which are difficult to decompose (crop residues, small twigs), with young and sappy materials, which are easily decomposable (fruit, vegetable skins, young leaves). This is because different types of organic matter contain different proportions of carbon (C) and nitrogen (N). The micro-organisms who decompose the organic matter need both carbon and nitrogen to function well.

In general, young, living material that decomposes fast contains low levels of carbon but high levels of nitrogen. Tough, dead material decomposes slowly and contains large amounts of carbon but low amounts of nitrogen. Too little nitrogen-rich material means the composting process will be slow, too much of it will result in the heap becoming acid and smelly. The ideal ratio of carbon and nitrogen for starting a compost pile is: C : N ratio = 25-30:1

Examples of nitrogen-rich materials are:

- Young leaves, all types of manures, fish meal, fish waste, urine, leguminous plants.

Examples of carbon-rich materials are:

- Dry leaves, crop residues of maize, sugarcane, rice, etc., twigs, wood shavings, coffee pulp, carton, etc

Proper composting materials contains

- ✓ Contain plant nutrients NPK
- ✓ Improves the organic matter in the soil by providing humus
- ✓ Helps the soil hold both water and air for plants
- ✓ makes trace elements or micro nutrients available to plants
- ✓ helps farmers improves the productivity of their land and their income
- ✓ Have a good balance of carbon and nitrogen
- ✓ Provide space for air to circulate

- ✓ Good water and air balance
- ✓ Sufficient water helps for quicker decomposition
- ✓ Without excess water causes rotting the materials
- ✓ Important of air

3.2. Identifying the major sources of raw matters

Composting a mixture of organic wastes makes decomposition easier and produces a more balanced end product. Sometimes there is a large quantity of one type of material and there is little chance of this being mixed with other materials. Samples of crop residues; used mushroom compost; common compost; green manure; municipal wastes; domestic waste, human waste or sewage**,** swine, cattle, and poultry manure; residues after oil extraction; and animal by-products were analyzed for the chemical composition of their nutrient contents.

3.2.1. Crop Residues

Rice straw, rice hull, and other straws of graminaceous crops with abundant fibrous materials usually have a high C:N ratio, with a low nitrogen content but fairly high potassium and silica contents . Potassium and silica help improve the resistance of crops to disease and lodging, and fibrous materials provide an energy source for soil microorganisms as well as improve and condition soil physical properties. Crop residues are used as mulches to cover the surface of the soil and help maintain favorable soil moisture content and temperature as well as prevent the accumulation of salts or the multiplication of weeds on the soil surface. These materials can well be combined with swine or poultry manure that has a high nitrogen content to make better compost for crops.

3.2.2. Composting coffee pulp

In coffee producing areas, large quantities of coffee pulp are a problem. The fermenting piles give off unpleasant smells; breed flies and pollute waterways. Coffee pulp is a good fertilizer as it is rich in organic matter, nitrogen and potassium. Some growers spread the heavy wet pulp on their coffee plantations but there can be problems with transport and spreading and this can

lead to smells and plant growth problems. It is much better to compost the material first so that it can be used more effectively.

3.2.3 Green Manure

Leguminous green manure crops are an important source of natural nitrogen. They fix nitrogen from the air and at flowering stage are usually incorporated into the soil, about ten days before planting the main crop. In extensively cropped areas, green manure crops are of great value to farmers since they reduce fertilizer costs. In intensively cropped areas, they may compete with the main crop for land. However, even in areas with very intensive multiple cropping systems like in Taiwan, some farmers are still growing sesbania sesban or crotalaria juncea as a green manure crop in summer, and berseem clover, milk vetch, and rape in the winter fallow season before planting the main crop like rice, corn, and sorghum. The chemical composition analysis of these green manure crops is shown in.These green manure crops that have low C:N ratio (lower than 20 at vegetative stage) can be considered primary sources of nitrogen.

Figure:3.1. Green manure

3.2.4. Mushroom

With the rapid development of the mushroom industry, used mushroom compost has become a good source of organic manure in Taiwan in recent years. Such compost consists mainly of sawdust and added with materials such as limestone and rice bran. Used mushroom compost has low potassium content as a result of leaching losses during mushroom culture, but the phosphorus, calcium, and C:N ratio and organic matter contents remain high. Also, used mushroom compost has a high fibrous material content which improves soil physical properties and biological activity. However, the remnant mycelia in these materials may sometimes have a harmful effect on the roots of some crops. Therefore, it is recommended that used mushroom compost should be combined with a proper amount of high-nitrogen manure such as swine or poultry manure or oil extraction residues and be well fermented to kill the mycelia, before applying to the soil.

Figure 3.2. mushroom

3.2.5. Animal Manure (Cattle, Goat, Swine, Chicken)

The nutrient content of swine manure is slightly higher than that of cattle manure, but with a higher copper content and lower content of fibrous material, discouraging repeated, long-term applications of this manure It is best to dilute this manure by mixing it with rice hull, sawdust, rice straw, and similar fibrous materials and fermenting it before use. The nutrient content of chicken manure is much higher than that of swine manure However, its higher content of zinc and antibiotics and lower content of fibrous material discourage direct applications of fresh poultry manure to the soil. The best way to utilize this manure is to mix it with cattle and swine manure, rice straw, rice hull, sawdust, and other fibrous materials, and ferment it thoroughly before use.

Cattle manure has a reasonably high content of nitrogen, potassium, and fibrous materials. It is good animal manure because it does not have heavy metals and antibiotics in it. Repeated applications of this manure to the soil can be recommended, but phosphorus should be supplied from other sources to make up for its shortage in this manure. Nutrient content of goat manure is slightly higher than that of cattle manure.

Figure: 3.3. Cattle manure

3.2.6. Residues from oil extraction

Oil extraction residues from oil seeds generally have high nitrogen content and low level of carbonaceous material. Liberal applications of this material to the soil may greatly promote the growth of a crop's vegetative parts. However, crops given this treatment are usually weak and easily attacked and damaged by plant pests and environmental stresses. As well, applying these residues to the soil when they are still fresh often attracts large numbers of soil-borne insects, which may also harm the crop. It is best to mix these seed residues with rice hull, sawdust, mushroom compost, bone meal, oyster shell, among other things, and fully ferment the compost before use.

3.2.7. Residues from processing animal products

The nutrient contents of animal residues differ greatly according to the type of residue. Animal blood, meat, horn, feet, wool, and feathers can all be used as a source of nitrogen fertilizer since they all have very high nitrogen content. Oyster shell and eggshell are good sources of calcium and bone meal can be a good source of phosphorus. However, all of them are very low in potassium. Fur should not be used in composting because of its high chromium content that can easily accumulate in the soil, causing toxicity in crops.

3.2.8. Composting domestic waste

Domestic waste includes any kind of decomposable household waste such as kitchen scraps, paper, sweepings or wood ash. It should not include meat or slaughter wastes. These attract vermin and insects and give an unpleasant smell. Neither should it include excreta from humans, cats nor dogs as these contain toxins, which can be harmful if not composted properly.

Figure:3.4. Domestic waste

3.2.9. Composting human waste or sewage

Composting human waste or sewage is a useful way to dispose of it and it is a good source of nutrients for plants. There are however a number of problems in dealing with human waste or sewage. Diseases can spread through handling the waste and through the consumption of the crops grown on this composted human waste. It is very important to use appropriate methods when dealing with it and to have previous experience of the composting process.

3.2.10. Additives

Additives can also be material added to the initial compost mix to adjust the C:N ratio or pH of the initial mix, or to attempt to control odors. Additives used to adjust the C:N ratio include fertilizers, urea, or other concentrated sources of nitrogen. These additives lower the C:N ratio without altering the moisture content of the mix and often provide the required amount of nitrogen at a lower cost than some other source. The drawback to using a concentrated source

of nitrogen to lower the C:N ratio is that the nitrogen is available at a faster rate than the organic carbon. This may result in an accumulation of nitrogen that is lost as gaseous ammonia or leached from the pile.

- May include, but not limited to:
  - ✓ Biological inoculants that aid the processing of particular
  - ✓ Raw materials or manufacture of compost products with particular attributes
  - ✓ Ferrous sulphate or other chemical additives
  - ✓ Lime
  - ✓ Nutrients
  - ✓ Urea.

Table 1. The major nutrient contents of main raw materials

Name of materials	Natural dried			Fresh		
	N%	P%	K%	N%	P%	K%
Dejecta & Urine	**4.689**	**0.802**	**3.011**	**0.605**	**0.175**	**0.411**
Human D & U	9.973	1.421	2.794	0.643	0.106	**0.187**
D	6.357	1.239	1.482	1.159	0.261	**0.304**
U	24.591	1.609	5.819	0.526	0.038	**0.136**
Pig D & U	3.773	1.095	2.495	0.238	0.074	**0.171**
D	2.090	0.817	1.082	0.547	0.245	**0.294**
U	12.126	1.522	10.679	0.166	0.022	**0.157**
Horse D & U	2.552	0.419	2.815	0.378	0.077	**0.573**
D	1.347	0.434	1.247	0.437	0.134	**0.381**
Cattle D & U	2.462	0.563	2.888	0.351	0.082	**0.421**
D	1.560	0.382	0.898	0.383	0.095	**0.231**
U	10.300	0.640	18.871	0.501	0.017	**0.906**
Sheep D	2.317	0.457	1.284	1.014	0.216	**0.532**
Chicken D	2.137	0.879	1.525	1.032	0.413	**0.717**
Rabbit D	2.115	0.675	1.710	0.874	0.297	**0.653**
Duck D	1.642	0.787	1.259	0.714	0.364	**0.547**
Goose D	1.599	0.609	1.651	0.536	0.215	**0.517**
Silkworm D	2.331	0.302	1.894	1.184	0.154	**0.974**
Stall Manure	**0.925**	**0.316**	**1.278**	**0.429**	**0.137**	**0.487**
Pigsty M	0.958	0.443	0.950	0.376	0.155	**0.298**
Stable M	1.070	0.321	1.163	0.454	0.137	**0.505**
Bullpen M	1.299	0.325	1.820	0.500	0.131	**0.720**
Sheep code M	1.262	0.270	1.333	0.782	0.154	**0.740**
Straw	**1.051**	**0.141**	**1.482**	**0.347**	**0.046**	**0.539**
Rice S	0.826	0.119	1.708	0. 302	0.044	**0.663**
Wheat S	0.617	0.071	1.017	0.314	0.040	**0.653**
Maize S	0.869	0.133	1.112	0.298	0.043	**0.384**
Soybean S	1.633	0.170	1.056	0.577	0.063	**0.368**

Rape S	0.816	0.140	1.857	0.266	0.039	**0.607**
Potato S	2.403	0.247	3.581	0.310	0.032	**0.461**
Sweet Potato S	2.131	0.256	2.750	0.350	0.045	**0.484**
Groundnut S	1.658	0.149	0.990	0.572	0.056	**0.357**
Broad Bean S	2.215	0.204	1.466	0.482	0.051	**0.303**
Tobacco S	1.295	0.151	1.656	0.368	0.038	**0.453**
Agri – by – product						
Rice Husk	0.310	0.034	0.307			
Maize Cobs	0.606	0.071	0.542			
Bagasse	1.001	0.128	1.005	0.205	0.043	**0.511**
Bean Cake	6.684	0.440	1.186	4.838	0.521	**1.338**
Oil P Cake	5.250	0.799	1.042	5.195	0.853	**1.116**
Wine P Residue	2.867	0.330	0.350	0.714	0.090	**0.104**
Cassava Residue	0.475	0.054	0.247	0.106	0.011	**0.051**
Sea Manure	**2.513**	**0.579**	**1.528**	**1.178**	**0.332**	**0.399**
Urban Residue	**0.319**	**0.175**	**1.344**	**0.275**	**0.117**	**1.072**
Rural Residue	**0.882**	**0.348**	**1.135**	**0.317**	**0.173**	**0.788**
Mixed Manure						
Soil Manure	o.239	0.247	1.620	0.183	0.102	**1.530**
Fertile Soil	0.555	0.142	1.433	0.207	0.099	**0.836**
Humic Acids	**0.956**	**0.231**	**1.104**	**0.438**	**0.105**	**0.609**

Source:1979 Rodale Guide of Composting

❖ **Micro-organisms**

The composting process happens due to the activity of microorganisms and other larger organisms like worms, earthworms and beetles. The first condition for composting is the presence of the composting organisms. Adding these organisms to the heap can be done by mixing ready-made compost with the organic materials. If there is no compost the soil can be added. Collect this soil preferably from a shady and humid place, e.g. from below trees. Soil that contains moisture contains micro-organisms. Soil that has been dried out by the sun usually does not contain many living organisms anymore.

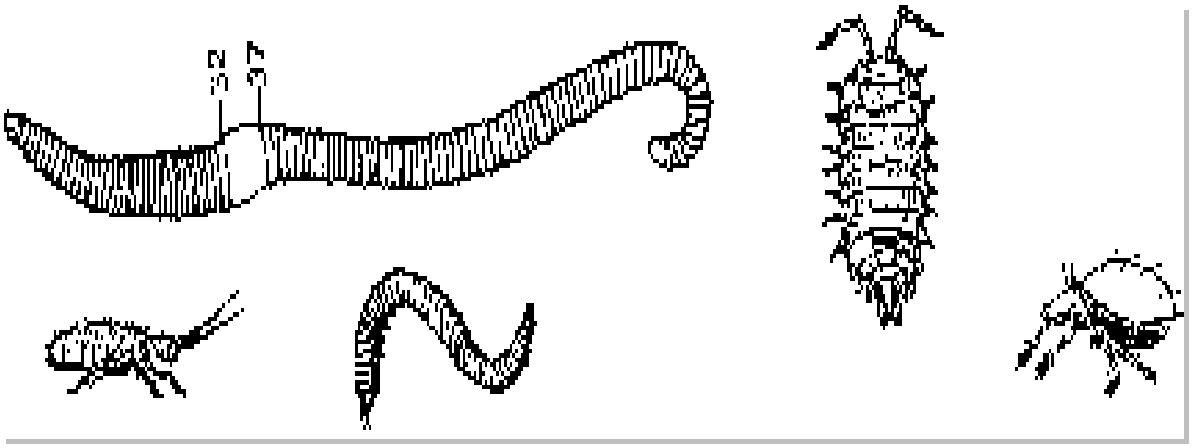


Figure 3.5. Micro-organisms

- **Air**

The micro-organisms in the heap require oxygen to survive and to do their work converting the organic material. The carbon dioxide which is produced by the micro-organisms as a result of their activity needs to be blown out by a flow of air. If there is not enough air in the heap, the useful micro-organisms will not survive. Other micro-organisms that do not need oxygen will thrive and decomposition of the organic material will slow down.

- **Moisture**

The micro-organisms need moisture to live and to spread through the heap. The activity of the organisms will slow down if the heap is too dry. But if the heap becomes too wet, then there will not be enough air and the composting organisms will die. This will cause the heap to ferment rather than compost. Judging the right amount of water requires a little experience.

- **Moisture test**

The moisture level of a compost heap can be tested easily. Put a bundle of straw in the heap. If after 5 minutes it feels clammy, then the moisture level is good; if still dry after 5 minutes, the moisture level is too low. Thermometer use to test the moisture content of cmpost.

- **Good top soil and old compost:** these contain bacteria, fungi and many small animals to work on breaking down the materials into mature compost.
- **Ashes:** they contain phosphorous, potassium and many micro-nutrients like zinc, iron and magnesium. And also neutralize acid produced during decomposition.
- **Methods of Compost Preparation**

There are two methods of making compost. These are:

1. **Pit Method** –it is a compost making process in pits, which is much better to be used in moisture stress and cold areas. This is because in moisture stress areas the pit keeps the available moisture for a longer time while in the cold, the pit keeps the inside temperature high enough for the decomposition process to continue.

Figure 3.6. pit composting

2. **Heap or Piling Method** – piling method is a compost making process on the surface. It is an appropriate method for areas where there is excess moisture.

Figure 3.7.. pit composting

❖ **Comparison between methods of composting:-**

Heap method

- Can be made in the open, less labour required.
- Moisture temperature and aeration in the heap can be easily controlled because the heap is exposed. However, in dry zones evaporation is high and heaps should be protected.
- No problem of excess of water because the water is drained out freely.
- The heap is easy to turn and mixed for aeration (necessary to accelerate the break down.)

Pit method

- Labour is required for digging the pit.
- Moisture temperature and aeration are difficult to control. However, in dry climate and high temperature, pits need less watering and keep moisture longer.
- The problem of water logging can easily occur, especially during the rainy season.
- Excess of water reduces the breakdown of organic residues.
- More difficult to turn and mix for aeration (more labour requirement).

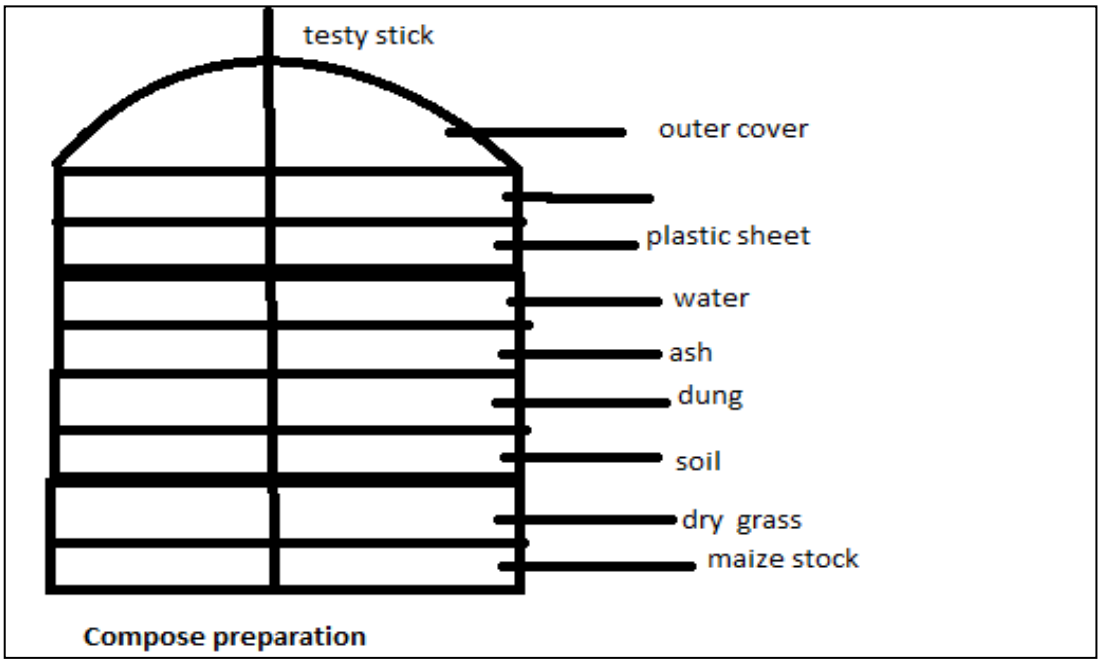


Figure: 3.8. Compost building layer procuders

Self-Check 3	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. List row materials for composting? (2points)
2. Discuss advantages of crop residues? (2points)
3. Compare cattle, goat, swine and chicken manure? (2points)
4. Write reasons for composting agricultural wastes for fertilizer use? (2points)

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

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer shee

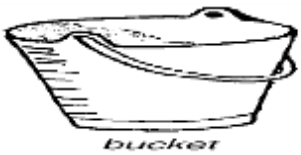
Information Sheet-4	Selecting appropriate hand tools

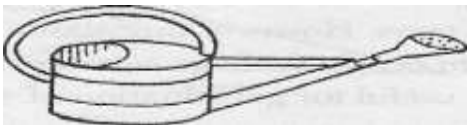
4.1. Material, tools and equipments

Table 4.1. Materials, tools and equipment use during composting

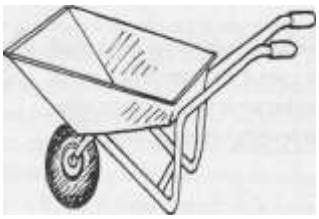
Materials	Tools	Equipment
Wood ash	Graduated stick	Thermometer
Green leaves	Rope	Wheel barrow
Plant residues	Tape meter	PPE
➢ Barley	Pick axe	
➢ sorghum and maize straw	Watering can	
➢ Bean	Rake	
➢ Wheat e.t.c	Peg	
Top soil and ash	Hammer	
Water	Machete	
Animal dung and urine	Shovel/spade	
Chicken manure		

Spade





Watering can



Wheel barrow

Pick axe

Rake

Machete

sickle

Figure :4.1 hand tools use for composting.

Self-Check 4	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. List hand tools use to collect composting raw materials?(3points)

Note: Satisfactory rating – 3 points Unsatisfactory – 3 below points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer shee

Information Sheet-5	Identifing occupational health and safety hazards

5.1. Health and safety

Health and safety measures should be incorporated into the design of the facility to mitigate operator fatigue and the potential for injuries, as well as downtime due to human-error-related incidents. In organic processing facilities, there are somewhat unique conditions that should be taken into account. One critical consideration is the air quality within the facility and the potential for personnel to be exposed to elevated levels of air contaminants (example; ammonia, methane, carbon monoxide, dusts and bioaerosols). Typically, occupied areas within organic waste processing facilities are designed with six or more air changes per hour. Ventilation systems are often supplemented with source capture systems around unit processes, such as mixing and screening operations, and open processing vessels or piles. Where possible, processing technologies and material handling systems should be designed in a manner that controls temperature and humidity within buildings. This is necessary to prevent fog from developing inside the building, which can reduce visibility and lead to accidents.

❖ **Occupational health and safety**

Definition: Occupational health and safety is concerned with health and safety in its relation to work the working environment.

❖ **Aims of occupational health and safety**

Occupational health should aim at:-

- The promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupation.
- The prevention amongst workers of departures from health caused by their working conditions.
- The protection of workers in their employment from risks resulting from factors adverse to health.
- The placing and maintenance of workers in an occupational environment adapted to his physiological and psychological capabilities.
- To summarize the adaptation of worker to man and of each man to his job.

❖ **Hazards**

Identifying OHS hazards

Hazards are risks that occur when providing organic production work support that could affect our health or our safety. In the different activities there could happen different hazards to our health and safety this could be identified as;-

- ✓ Poisoning from air
- ✓ To be dust and noise
- ✓ Solar radiation
- ✓ Sharp hand tools
- ✓ Soil borne micro organisms
- ✓ Sun hitting the support provider

Self-Check 5	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. List the hazards occuring during of compost raw materials collection?(1points)
2. List aims of occupational health and safety (4points)

Note: Satisfactory rating – 5 points Unsatisfactory –5 below points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Information Sheet-6	Selecting suitable personal protective equipment

6.1. Personal protective equipment

Personal protective equipment is to include that prescribed under legislation, regulations and enterprise policies and practices**.** Suitable personal protective clothing and equipment is selected, used, maintained and stored in accordance with “Occupational Health and Safety” requirements during raw materials collection.

6.2. Select personal protective equipment

Consider these factors when selecting personal protective equipments (PPE):-

- Type of hazardous materials, processes, and equipment involved.
- Routes of potential exposure (ingestion, inhalation, injection, or dermal contact).
- Correct size for maximum protection.
- Minimal interference with movement.

Personal protective clothing and equipment may include:-

- ✓ Hoots
- ✓ Hat/hard hat
- ✓ Overalls
- ✓ Gloves
- ✓ Protective eyewear
- ✓ Hearing protection]
- ✓ Respirator or face mask
- ✓ Sun protection, e.g., sun hat.

Different types of PPE are described below

Eye protection: Use safety glasses for minor splash hazards, goggles for moderate hazards, and goggles combined with a face shield for severe hazards.

Hand protection: Hand protection is indicated for the possibility of severe cuts, lacerations, or abrasions, punctures, temperature extremes, and chemical hazards. (Nit rile loves are usually a good choice for general use.) Use heavy-duty gloves for non-incidental contact and gross contamination.

Body protection: Protective clothing includes lab coats, smocks, scrub suits, gowns, rubber or coated aprons, coveralls, uniforms, and pierce-resistant jackets and vests.

Head protection: Hard hats must be worn by electricians, construction workers, and any other workers when there is a danger of objects falling from above.

Figure:6.1.

Self-Check 6	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. List personal protective equipments?(2points)
2. Menstion the considering critrias during personal protective equipments?(2points)

Note: Satisfactory rating – 5 points Unsatisfactory –5 below points

You can ask your teacher for the copy of your answer

Score = _____

Rating= _____

Name: _____ Date: _____

Answer sheet

Operation Sheet-1	Identifying raw materials

Objectives: - at the end of this practice the trainees will able to:-

- Identify materials and tools used for raw materials preparation
- Select suitable raw materials for composting

❖ **Procedure**

To selct all raw materials for composting, follow the following procedures.

1. Prepare materials, tools and equipment's use raw materials collection
2. Wear suitable personal protective equipment
3. Select site where raw materials are available
4. Identify OHS hazards
5. Collect raw materials
6. Rject contaminant raw materials
7. Dispose wastes safely
8. Clean and store tools and equipment's

Operation Sheet-2	Building the heap composting

Objectives: - at the end of this practice the trainees will able to:-

- Know the building layer raw materials
- Know heap method composting

❖ **Procedures**

To make heap method compost building technique, follow the following procedures

- Select a site where to make the compost
- Mark out the area for heap compost
- Dig a trench about 20-25cm deep
- Chop rough and long plant material to 5cm-12cm

Begin building a bottom layer with 20cm thick rough materials such as maize stalk and sprinkle some water in this layer

- Add a 2nd layer of dry vegetation grass with15cm thickness. and sprinkle the water on
- The next layer should be of green materials about 15-20cm thickness
- Sprinkle on a little topsoil or old compost.
- Put on a third layer of animal manure or biogas slurry.
- Sprinkle some ash or dust on this layer and then add water.

Figure:2.1. Heap composting

Operation Sheet-3	Building the pit composting

Objectives: - at the end of this practice the trainees will able to:-

- Know the building layer raw materials
- Know pit method composting

Procedure

To make pit method compost building technique, follow the following procedures

- Select a site where to make the compost
- Mark out the area for heap compost
- Dig a trench about 20-25cm deep
- Chop rough and long plant material to 5cm-12cm
- Begin building a bottom layer with 20cm thick rough materials such as maize stalk and sprinkle some water in this layer
- Add a 2nd layer of dry vegetation or grass with15cm thickness. and sprinkle the water on
- The next layer should be of green materials about 15-20cm thickness
- Sprinkle on a little topsoil or old compost.
- Put on a third layer of animal manure or biogas slurry.
- Sprinkle some ash or dust on this layer and then add water.

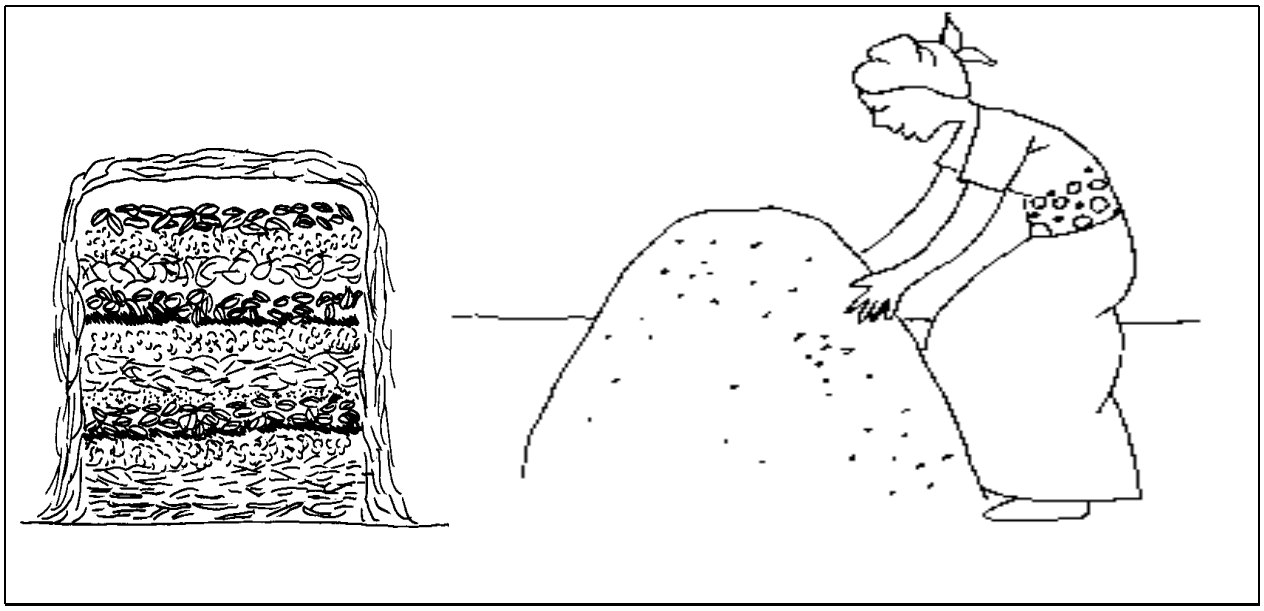


Figure:3.2. Pit Composting

LAP Test	Practical demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: You are required to perform the following as directed

Task 1. Identifying raw materials for composting?

Task2. Building the heap composting?

Task 3. Building of pit composting?

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1. Arun. sharma .2002. A Hand book of organic farming Agrobios India.tht
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Horticultural Crops Production

Level II

Learning Guide-33

Unit of Competence:- Collect Raw Materials for Composting

Module Title:- Collecting Raw Materials for Composting

LG Code: AGR HCP2 M09 LO2-LG-33

TTLM Code: AGR HCP2 TTLM 0120v1

LO2: Receive and process raw materials

Instruction Sheet	Learning Guide 33

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

- Maintaining effective communication with raw material suppliers
- Documenting specification and acceptability of raw materials
- Determining preferred suppliers of raw materials
- Documenting and incorporating management requirements
- Confirming site infrastructure, plant and equipment requirements
- Documenting, rejecting and reporting unacceptable (non-conforming) materials
- Measuring acceptable raw materials
- Calculating raw material fee
- Recording received raw material fee

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 –

- Maintain effective communication with raw material suppliers
- Document specification and acceptability of raw materials
- Determine preferred suppliers of raw materials
- Document and incorporating management requirements
- Confirm site availability of infrastructure, plant and equipment requirements
- Document, rejecting and reporting unacceptable (non-conforming) materials
- Measure acceptable raw materials
- Calculat raw material fee
- Record received raw material fee

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 4.
3. Read the information written in the information “Sheet 1,2,3,4,5,6,7,8 and 9”
4. Accomplish the “Self-check 1 1,2,3,4,5,6,7,8 and 9”” in page -47, 50, 52,56, 62,64, 67,71 and 73 respectively.

Information Sheet-1	Maintaining effective communication with raw material suppliers

1.1. Maintaining effective communication with suppliers

Maintaining effective communication in which commonness is established between supplier and user of a compost raw materials. Supplier relationship management (SRM), in simplest terms, refers to interacting with and managing third-party vendors that provide goods, materials, and services to prepare quality copost. It sounds easy enough—you choose suppliers that are cost-efficient and easy to work with to maximize the value of the relationship.

1.2. Approaches to suppliers relation managments

Reactive Approach – Where companies start managing the supplier relationships only when unpleasant situations with suppliers occur, and try to figure out how to improve the performance of unreliable suppliers. This approach consumes quite a lot of time and resources, which could have been better spent on more important compost raw materials preparation processes.

Strategic approach – Where supplier relationship management starts even before an agreement with supplier is signed, in order to ensure the competitive advantage of the company in the long run. This is a forward-focused approach, which can lead to a successful relationship even in the early stages.

1.3. Supplier management solutions and strategies for better relationships

Having long-lasting, trusted relationships with dedicated suppliers should be a primary goal of any business that strives to succeed in the market, so let’s find out which strategies can help achieve this;-

1. Your suppliers are not just vendors: They are your partners, and this partnership should be based not only on financial transactions, but also on mutual trust and loyalty. Make your suppliers feel like they are a part of your business. Inform them about your processes, such as releases of new products and promotions, and listen to their concerns.

2. Technology makes supplier relationship management simple

You can even go further and install advanced purchase order management software, which you can use to create, process, and track purchase orders with your suppliers. Some software solutions, like Purchase Control integrate these supplier management solutions functions into the same platform.

3. Realize that timely payments are crucial

If you don't want to lose your suppliers, step one is making sure to pay them on time. This way, you will prove that you are a reliable customer and that you're easy to work with. If for any reason you cannot make the payment on a date agreed, then inform the supplier as soon as possible with the date on which they can expect the payment. Suppliers like timely payments just like you like timely action on their side.

4. Relationships should be strong and deep

Make sure to maintain strong and regular communication with each of your suppliers. Keep them regularly informed and up to date, on your strategy and plans so that they know where they fit in and how they can help, plan for and benefit from those plans. Make them your partner. If you appreciate their work, let them know. If something's not working for you, let them know. A stronger, deeper relationship with clear and frequent communication allows this communication to become more organic.

5. Price is what you pay, value is what you get

Nothing is better for growing your profits than getting a quality service or materials for the right price. If you have the financial flexibility use it. You can buy in bulk and get better pricing but you will have more stock on your balance sheet, or you can arrange to pay a vendor earlier in order to get a bigger discount. Sometimes its better to pay a little more because the supplier is giving you a better service which pays for itself because you need to provide less time to manage them, or because they can be trusted to deliver directly to your customer. As noted in the above, relationships are important, but you shouldn't stick with a supplier just because you like them. Choose the most efficient services for your business, and realize that efficiency is a product of value not just the cost.

1. The suppliers are not just vendors: They are partners, and this partnership should be based not only on financial transactions, but also on mutual trust and loyalty. Make them self feel like they are a part of the business. Inform them about the processes, such as releases of new products and promotions, and listen to their concerns.

2. Technology makes supplier relationship management simple

You can even go further and install advanced purchase order management software, which you can use to create, process, and track purchase orders with them. Some software solutions, like purchase control integrate those supplier management solutions functions into the same platform.

3. Supply on time raw materials when necessary

Suppliers step one is making sure to bring raw materilas on time. This way, you will prove that you are a reliable customer and that you're easy to work with. If for any reason they can not bring on date of agreement, they inform the user as soon as possible before agreement date.

4. They should have be strong and deep relationships with the users

They maintain strong and regular communication with the compost raw materials users. Keep them regularly informed and up to date, on your strategy and plans so that they know where they fit in and how they can help, plan for and benefit from those plans. Make them partner with users. If they appreciate their work, let them know. If something's not working for they, let them know. A stronger, deeper relationship with clear and frequent communication allows this communication to become more organic.

5. Price is what users pay, value is what users get

Nothing is better for growing profits than getting a quality service or compost materials for the right price. If they have the financial flexibility use it. They can sell in bulk and get better pricing but will have more stock on their balance sheet, or they can arrange to sell for user earlier in order to get product. Sometimes its better to pay a little more because the supplier is giving you a better service which pays for itself because you need to provide less time to manage them, or because they can be trusted to deliver directly to your customer. As noted in the previous section, relationships are important, but shouldn't stick with a supplier just because they like them. Choose the most efficient services for business, and realize that efficiency is a product of value not just the cost.

6. **Detailed agreements make supplier relationships easier**

If users are buying from a vendor on a regular basis, supplier relationship agreements are a must. Write down everything that both parties expect from their partnership such as item or service description, drice, delivery terms, payment terms, communications, and so on, and then have both parties sign it. This can be a simple or complicated document depending on your business requirements. A well documented supplier relationship agreement will reduce the possibility of confusion or disputes. It's often a good idea to create a flowchart or deck to explain the process to your team, so everyone knows their duties and can recognize if something goes wrong in the workflow.

7. Evaluate the risks

Always evaluate the risks of dealing with a supplier, especially if they have a complex supply chain. Ask for references, examples of their previous work, years in business, areas of

expertise, how they deal with a crisis, what they did the last time they had to deal with a crisis, and so on.

- ✓ Are they competitively priced?
- ✓ Do they have the right experience?
- ✓ Do they have the capacity to deal with users orders?
- ✓ Are they financially stable?

These are just some of the questions the users should be asking. May be the user select the suppliers is not the cheapest but guarantees 100% on-time delivery with a money back offering; users can live with that because a chain is only as strong as its weakest link, and if user vendor lets down their whole supply chain may be at risk, which can affect ability to deliver to customers. In business, things go wrong, by evaluating your vendors risk profile in tandem with a good Supplier Relationship Agreement, you can mitigate the risks and be ready to deal with any emergencies in partnership with your vendors, which can help minimize interruptions to your business.

8. A dedicated SRM process is a worthy investment

Create a documented process that will help guide team through the management and administration of suppliers. In a large organization this can include flow charts, policy documents and agreements document that covers all of the points of agreement for you and the vendor. Make sure that all the steps are followed and that documents are signed off when completed.

9. Not all suppliers are made equal, think global act local

As the world becomes ever more connected, we increasingly find themselfs dealing with vendors that are further afield, either across the country or across the globe. Attitude toward work always varies from culture to culture, so be aware of this and make sure that you are okay.

Self-Check 1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

5. List approaches to suppliers relation managments?(2points)
6. What are the importance of maintaining effective communication with suppliers?(2points)

Score = _____

Rating: _____

Answer

Note: Satisfactory rating – 4 points **Unsatisfactory - below 4 points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Documenting specification and acceptability of raw materials

2.1. Documenting specification

The proposed uses of the final compost products produced by the composting facility should be documented in the facility's design so that suitable allowances are made for post processing equipment, operations, and storage space.

In particular, the desired level of compost product stability and maturity must be considered and documented in the residence time of materials in the active composting system and curing area. If sufficient residence time is not provided, material may not meet customer expectations or requirements, and alternative markets may need to be explored.

Similarly, end-user particle size requirements and their tolerance for contaminants are factors in the selection of the type of screening and refining equipment use should be documented.

2.2. Documenting acceptability of raw materials

Keeping complete documenting of raw materials and their specification and acceptability. This includes information about the preparation of compost, the source of the starting material, details of composting procedures, and the results of microbiological tests on the composted material. Records should also be kept on the dates, amounts, quality,acceptability of raw materials. These records will help to verify that appropriate steps were taken to ensure the safety of the composting and to trace both the origins of the used materials used and other products from the growing area, when required.

Suggestions for information to be documented:

- Origin of the organic materials used
- Specification of raw materials
- Date of collected
- Area where they access
- Treatments applied
- Amount of raw materials collected
- Date of collection
- Person address responsible for collection

Documenting be kept for other important process parameters, namely: oxygen level, moisture content, pH, and bulk density. An ongoing data base of these parameters, in addition to temperature information, can be used to optimize the compost process management strategy for improved product quality and more efficient production time.

On a day to day basis, this information can be used to identify sub-optimal composting conditions and prevent them from becoming problematic. It is also advantageous to keep track of all changes to the standard process management plan. Recording dates and amounts of all amendments (such as water, fertilizer, and bulking agents) that are made to the composting feedstock will provide invaluable insight that can be used to optimize composting conditions in future batches. Similar benefits can be obtained from logging dates and duration of aeration events. Another valuable record to maintain is that of feedstock and final compost analysis results. An on-going data base of feedstock and compost properties could be used with other activity records to identify process management practices that are best suited to compost specific feedstock materials into a high quality product.

Self-Check 2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. List the importance of documenting specification of raw materials?(3)
2. List the importance of documenting acceptability of raw materials?(3)

Answer

Score = _____

Rating: _____

Note: Satisfactory rating – 6 points **Unsatisfactory - below 6 points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Information Sheet-3	Determining raw materials suppliers

3.1. The determining of raw materials suppliers

Evaluating your raw materials suppliers to the benefits of a given procurement and project delivery model should consider several criteria that are essential to defining a successful procurement and follow-on project:-

Transparent: All procurement processes, methodologies, and selection criteria must be fair, objective and transparent to the professional services and construction community.

Cost-effective: Any procurement methodology should ensure that the owner is receiving best value for the services and construction being purchased. To the extent possible, services should be priced, and price should be evaluated as part of the selection methodology.

Objective-focused: Procurement selection strategies should be based on clearly defined evaluation criteria that mirror project challenges and opportunities for project success.

Efficient: The cost for implementing the procurement process should be minimized in favour of using funding to maximize delivery of actual project scope. Similarly, the bidding community's resources should be respected by minimizing to the extent practical the cost topropose on work.

Timely: The duration of the procurement processes should be minimized, allowing for sufficient response time from bidders and a reasonable time period to evaluate proposals without other undue delays. Valuable time should be conserved and made available for execution of project scope.

Inclusive: The overall procurement process should ensure that local subconsultants and sub contractors have equal access to project scope for which they are qualified. Projectsshould be packaged for wide participation, especially for alternative delivery models that might otherwise preclude local firms from at-risk work.

Compatible: Procurement methodologies must remain consistent with existing regulatory and procurement policies unless specific changes are approved to accommodate identified alternative delivery benefits. With this finally, take into account the time zone differences, i.e. know about the time slots in which the supplier is available for communication.

Self-Check 3	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

5. List the consider criteria to determiningmaterials suppliers?(2)
6. Differentiate transparent and cost effective procurement?(3)

Answer

Score = _____

Rating: _____

Note: Satisfactory rating – 5 points **Unsatisfactory - below 5 points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Information Sheet-4	Documenting and incorporating management requirements

4.1. Documenting raw materials

The following points should be beard in mind during documenting raw materials:

- Documenting raw materials accurately
- Documenting identified and assessed against specified acceptance criteria.
- Documentin the rejected or unacceptable (non-conforming) materials
- Non-conformances are documenting and reporting according to supervisor procedures.
- Acceptable raw materials are measured and quantity is recorded according to supervisor procedures.
- Recording fee based on raw materials type and quantity, and charged to customer according to supervisor procedures.
- Correct fee payment is received and recorded, and receipt is provided according to supervisor procedures.

4.2. Incorporating management requirements

Incorporate managements responsibilities around sourcing and processing raw materials, the type of raw materials accepted, and any fees involved. Properly assessing responsibilities around materials are critical to the composting success. The incorporate management practise during composting should be aswer the following questions;-

- **Sourcing**
  - Who will collect and weigh the waste?
  - Will the waste be collected, aggregated and delivered by the municipality, or will it be sourced on-site or in the community by the contracted party?
  - Is a community drop-off model relevant?
  - What changes are needed in waste collection from the status quo?
  - Who is responsible for the quality of the incoming feedstock?
  - Materials What feedstock materials can be used in the composting operation—agricultural waste, market waste, park and yard waste, source or processed municipal solid waste?
  - In what proportions can these waste streams be used?
  - Will any pre-mixing or treatment occur at a central locality before waste streams are delivered to the composting facility?
  - If not, how is the composting facility to manage this waste?

- What are upfront quality requirements of the feedstock input, and are there moisture, composition (e.g., wood, animal by-products), or contamination guidelines?
- Is the technology proposed consistent with the anticipated feedstock characteristics (e.g., moisture, nutritional content)?
- Will additional processing or additives be required?
- If the composter will be accepting feedstock from the municipality or communities, are there gate fees to be paid by the municipality to the contracted party and what price will be paid per ton?
- Will there be a fixed amount?

❖ **Production amount**

- How much of each type of compost should be produced each year (as a total amount or fraction of inputs)?
- How often will progress be measured?

❖ **Incoming materials**

- What are the guidelines for receiving incoming organic materials, unloading, sorting, debagging and grinding, screening, and removal of excess waste materials?
- Which roles should the owner be responsible for vs. the operator?
- What is the maximum hold period for feedstock delivered, that is, should feedstock be processed within a certain time period of receipt?

❖ **Process and hygiene**

- What are the requirements on incubation vs. turning (and other technical standards)?
- What is the frequency of temperature monitoring and maximum temperatures that can be reached in the piles?
- What additional steps should be taken to maintain compost hygiene and safety, such as material mixture, odor control, and pile fire avoidance?
- Who is responsible for providing equipment (and back-up equipment) along the production chain (e.g., trucks will be supplied by the municipal waste association, but windrow turners, tractors by composting cooperative or farmer)?
- What other assets and equipment will be used, and who will provide them (scales, trailers, appliances, tools, labor, fuel, and storage)?
- What technology that should be used, for example, open windrow composting vs. in-vessel technology (cost of equipment, maintenance, and complexity should be considered here—typically simpler is more sustainable)?

- Is a clean and secure storage area available for excess feedstock and compost?

❖ **Final processing steps**

- Who will weigh outputs?
- Who will dispose of reject materials and where will it go?

❖ **Quality assurance and final product testing**

- Who is responsible for output quality?
- What are requirements around final screening and trash removal? What is the required screen / maximum particle size?
- What are requirements around percent organic matter, percent moisture, maturity, and weed content?
- What does a clean, market-ready compost product look like in appearance?
- Who will submit a sample of the compost for testing?
- Who pays for testing?
- What certified facility should conduct the testing?
- What national or local certification, seals, or labels must be issued?
- What are the timing requirements around producttesting?
- How often will product testing occur?
- What happens to compost that does not pass standards (e.g., supplement with nutritional add-ins, use as filler, discard)?
- What are the nutritional standards of the end product?

Self-Check 4	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. List the important of incorporate managements requirement?(3)
2. List the consideration while documenting of raw materials?(3)

Answer

Score = _____

Rating: _____

Note: Satisfactory rating – 6 points **Unsatisfactory - below 6 points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Information Sheet-5	Confirming site infrastructure, plant and equipment requirements

5.1. Site infrastructure

When planning a composting system, there are several factors to consider. The reason for composting and the intended use of the finished compost material should be factors in the facility design.

5.1.1. Siting

Compost facilities should be located out of the path of runoff from surrounding areas. It may be necessary to divert surface runoff away from the composting area. Compost facilities should be located outside of floodplains and above seasonable high water tables. If site restrictions require location within a floodplain, they shall be protected from inundation or damage from an appropriate design storm. The selection of an appropriate design storm should include the economic damage that would occur due to a disruption to the composting process and potential environmental damage resulting from the release of any pollutants during a flood. Locate the composting area or facility on soils that would prevent contamination of groundwater resources. Proper management of the compost itself can prevent seepage from the compost pile. Providing 1 or 2 feet of dry compost or sawdust should be sufficient to prevent seepage if the moisture in the compost is carefully managed. Mechanical compaction of the soils may be necessary to reduce permeability of the soil to an acceptable level. Another option is the use of a synthetic liner. The synthetic liner should be protected by a covering of soil, stone, or gravel to protect it from damage. Care must be taken to protect and preserve this cover during the composting operations. A concrete slab is another alternative; it has the advantage of providing a stable working surface.

Consideration should be given to roofing the compost facility. Roofing could result in considerable cost, but it gives greater control over the moisture levels in the compost due to precipitation and reduces the possibility of contaminated stormwater runoff from the facility. Compost itself can be quite absorbent, and the additional water from precipitation may be a welcomed addition to the compost pile. Water penetrates the compost pile slowly, and once the surface has become wet, most of the precipitation runs off of the compost pile carrying little nutrients or pathogens. State and local laws and regulations may determine the amount of protection the compost operation must have from precipitation. Direct contaminated runoff from compost facilities must be directed to an appropriate storage or treatment facility for

further management. Even carefully managed compost facilities can develop odor problems. Consider the direction of prevailing winds and downwind areas where unpleasant odors could be nuisance and result in complaints. Also consider landscape elements, such as buildings, landforms, and vegetation, that could screen the composting operation and prevent it from becoming an eyesore.

5.1.2. Sizing for compost facilities

The size and configuration of the composting facility is dependent on the composting method; desired flow-through capacity of the composting facility itself; equipment used for transporting, loading, unloading, and aeration; curing capacity requirements; and storage requirements for both the feedstock and the finished product. Storage capacity for the composting feedstock and finished compost product should usually be determined separately from the capacity of the composting process itself. The engineer should design the composting facility with the capacity and flexibility for management of the composting process. If the client is new to composting, it may be advisable to start small, develop composting skills, and plan on future expansion rather than install in a complete facility. As composting skills are developed and composting efficiency is improved, the total area needed for composting becomes smaller.

5.1.3. Sizing for windrows

Large composting operations should consider windrows. The cross-sectional area and spacing of individual windrows is determined by the equipment used to turn the windrows. The number and length of the windrows is determined by the flow through capacity.

5.1.4. Sizing for bins

Small farm composting facilities can consider composting bins. When considering bin composting, the landowner should plan on a series of primary bins, secondary bins, and a curing/storage area. Typically, the material will remain in the primary and secondary bin about 15 days each and in the curing/storage area for an unspecified amount of time. Individual bins should be sized based on the equipment used to manage the bins. The front or opening of the bin should be about 2 feet wider than the blade on the front-end loader that will be used to turn the bins and the length from one to two times the dimensions of the width. The height should be about 5 feet. Stacking the feedstock deeper than this can lead to air exchange problems, resulting in the bin becoming anaerobic. A typical bin could be 8 feet wide, 10 feet long, and 5 feet high with a capacity of 400 cubic feet.

FiFigure:5.1. Operating areas in typical solid waste organics processing facility

5.2. Plant and equipment requirements

Front-end loaders, also called wheel-loaders, are a key piece of equipment used at most organic waste processing facilities. They can be used for a wide variety of tasks, including:

- Moving feedstocks and other materials
- Loading and unloading vessels
- Building windrows and stockpiles
- Turning and agitating piles
- Loading composting into screening equipment
- Loading finished compost product onto trucks
- Scraping and cleaning paved surfaces

Front-end loaders are available in a wide variety of sizes, ranging from 50 to 1600 horsepower (hp). The larger models are rarely used in the solid waste industry and are generally used in the mining industry. Front-end loaders in the 100- to 250-hp range are most commonly used at organic waste processing facilities.

Figure:5.2. Front-end loaders

5.2.1. Mixing Equipment

Several types of mixers are available and suitable for mixing high-moisture feedstocks, such as food waste with amendments. These mixers generally consist of a hopper with a mixing mechanism mounted on a vertical or horizontal shaft. These mixing units are not normally used for processing leaf and yard waste unless it has been pre-ground and is being used as an amendment material.

Figure: 5.3. Augers inside a vertical mixer

Self-Check 5	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. Which types site you select for composting facilities?(3)
2. List the raw materials mixer equipments?(3)

Answer

Score = _____

Rating: _____

Note: Satisfactory rating – 6 points **Unsatisfactory - below 6 points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Information Sheet-6	Documenting, rejecting and reporting unacceptable materials

6.1. Rejecting unacceptable materials

Raw materials are rejected when low permeability, contaminants, unwanted items and incompatible for composting operation. Removing the materials that have been delivered to the composting facility from containers or bags, and inspecting for unacceptable or noncompostable items (e.g., metal cans, glass bottles, and plastic film). Particular emphasis is usually placed on removing contaminants that could pose safety concerns to workers in the facility (e.g., sharps, and glass or metal pieces); damage equipment (e.g., large rocks and concrete pieces and empty pesticide containers); or negatively impact finished compost product quality (e.g., batteries).

6.2. Documenting and reporting unacceptable materials

Make documenting all unacceptable (non-conforming) raw materials of the following and reporting to the concerning person;-

- Contamination by different kinds of disease causing organisms.
- Different kinds of chemicals
- Primary human pathogens:
- Secondary pathogens and their toxins
- Volatile and semi-volatile organic chemicals of both synthetic and natural origin
- Metal cans, glass bottles, and plastic film
- Persistent, lipophilic organic chemicals.
- Inorganic materials (e.g., asbestos), and organometallics.
- Allergens from household and yard wastes.
- Corrosive, caustic, explosive and sharp materials.
- Eucalyptus,
- fuel (kerosene, diesel, petrol), engine oil & stones
- Any pieces of clothes
- Hyena cat and dog droppings
- Crops treated by chemical pesticides(up to 6 months)
- Avoid use of torn or spin trees branches leaves
- Any type of wax, any type of fat, hide/skin & etc.
- Weed seed

Self-Check 6	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. List the unacceptable raw materials?(4)

Answer

Score = _____

Rating: _____

Note: Satisfactory rating – 4 points **Unsatisfactory - below 4points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Information Sheet-7	Measuring acceptable raw materials

7.1. Weighing of raw materials

Source-separated incoming waste after collection from households and markets must be weighed using manual or electronic digital weighing machines. Usually rickshaw vans or trucks loaded with waste enter the gate and unload the waste in the unloading platform of the compost plant. Depending on the size of the plant weigh bridge, capacity can be from 250-500 kg. During this step, incoming waste can be weighed using 50-100 litre buckets or baskets. Plant operators should note the numbers of the licence plates and register them as incoming weight. It should be noted that keeping a record of incoming waste in a compost plant is required in order to claim in carbon trading as well as important in running the business. The important requirements are that both waste delivery and residual collection is regular and that waste is delivered in a fresh condition.

Figure:7.1. Weighing machines

7.2. Analysis of raw materials

Laboratory analysis of the raw material is important for operations that are in the beginning stages of setting up a compost operation and are attempting to establish a compost mix. Because the characteristics of the raw material vary between and within batches, literature values may not be appropriate. Laboratory analysis allows the operator to formulate a more ideal mix. Laboratory analysis of the raw material may also be prudent to determine if it

contains contaminants that may not degrade during the composting period. For example, heavy metals are in some cardboard that may be used in composting. Also, pesticides may be attached to some crop residue that may be used in composting. Analysis of the finished compost may be required to determine nutrient content if the compost is to be sold on the basis of its fertilizer content. Knowing the nutrient content of the finished compost that will be land applied helps determine proper application rates. Simple analyses can be performed on the farm using onsite testing equipment. More sophisticated analyses requiring specialized equipment and methods need to be performed by independent or agricultural laboratories. A sample of either the raw material or compost for laboratory analysis must be representative of the pile. To ensure that the sample describes the general qualities of the entire lot, several samples should be taken from different areas of the pile and then combined. A sample from this combined mix can then be taken for analysis. Samples taken from a compost pile should not be obtained from the edges, outer surfaces, or center. These are all regions of either very low or very high microbial activity and are not representative of the entire pile. A compost pile that has been stored outside and exposed to precipitation may also have different moisture and soluble salt concentrations at the edges and center of the pile. This is caused by water puddles that form at the base of the piles and the leaching of salts that concentrate at the center of the pile.

Self-Check 7	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. List the advantage of analysis of raw materials raw?(2)

Answer

Score = _____

Rating: _____

Note: Satisfactory rating – 2 points **Unsatisfactory - below 2 points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Information Sheet-8	Calculating raw material fee

8.1. Availability and price of raw material

The main raw material for most on-farm composters is manure or dead animals. Other on-farm material can be used as amendments such as crop residue and spoiled straw. Just about any organic waste produced on-farm that would have high disposal costs or presents handling difficulties should be considered. Composting this material reduces costs and improves its handling properties. The advantage of obtaining most or all of the raw material from on-farm is that material costs are generally minimal, and it reduces energy inputs into the composting process. Potential off-farm sources of raw material include other farms, municipalities, racetracks or stables, and food, fish, or wood processors. Preferable off-farm material is available either free or with a tipping fee and is compatible with a composting operation. Municipalities often pay a tipping fee to the compost operator for yard waste such as grass and leaves and cardboard and paper. The magnitude of the tipping fees varies depending on the cost of other methods of disposal available to the municipalities. The cost of wood chips and sawdust varies depending on the supply and competition for other uses. Straw that has limited use for other purposes can generally be obtained at nominal prices per bale. The cost of transportation for raw material must be considered in the evaluation. A material that is free for the taking may not be cost effective if the expense of hauling is excessive and must be paid by the compost facility.

8.1.1. Estimated costs of operation/production

After establishing the basic costs, the material, tasks, and equipment that will be used in the compost operation should be well in mind. Using this knowledge, production costs can be estimated to determine the economic feasibility of the operation. If the analysis reveals that it is not economically feasible, adjustments can be made before significant amounts of time and money have been invested into the operation. Production costs vary considerably from operation to operation and from month to month. This depends not only on the material, operation, and market, but also on other uncontrollable factors such as costs of labor, fuel, land, and equipment purchase and maintenance. A difficult item to determine is the profit from sale of compost. Compost operations may fail if overoptimistic estimates are used in the evaluation for marketing and sales.

8.1.2. Pre-startup cost

Costs associated with startup generally are one-time costs. These costs include the value of the land to be used and the labor, time, equipment, and capital investment involved in site preparation. Site preparation should include the cost of the planning that must be done to acquire necessary permits. Actual site preparation costs include the necessary grading, surfacing, drainage, and landscaping. Site preparation also includes any necessary surfacing of access roads to the composting site.

8.1.3. Material handling

Material handling is the primary cost in the production of compost. It includes both capital investment and labor and equipment investment. The amount of capital invested in material handling equipment depends on the method used and availability of on-farm equipment to the composting operations. Equipment needed that is not available on-farm must be obtained. Some automated turning equipment can be expensive. The options that could be considered include joint ownership by several farmers, leasing or purchasing used equipment. The cost associated with turning the piles must be considered. This cost depends mainly on the volume and bulk density of the material being turned and the equipment used for turning. High volumes and dense material require more time.The cost of turning decreases as the composting process advances because of the reduced volume of the material. The volume decreases by 50 to 80 percent over the duration of the composting period. The skill and experience of the operator along with the power and size of the machinery also influence the cost. A skilled operator can turn a windrow more effectively and in a shorter period than an inexperienced operator. Specialized windrow turners are often faster and provide a more thorough mixing and shredding of the material than a front-end loader or other adapted farm equipment. The negative aspect to these turners is that they require a large capital investment. If farm equipment is to be used, the increased wear and tear and subsequent maintenance costs also contribute to the operating costs.

8.2. Calculating raw material fee

The fee of raw materials for compost preparation very low cost or free for most farmers or user because most of raw materials easly available everwhere. For calculating fee of raw materials first calculate the volume of pit or the density.

Example

Assumption

How many compost boxes and maturing boxes are required for a 3 tons per day capacity compost plant?

- The daily density is calculated according to the following equation:-

$$\text{Density}\left(\frac{k}{M^3}\right) = \frac{\text{Mass}}{\text{Volume}}$$

Considering the collected raw material density;

- Mass=800kg
- Volume =height xwidthxlength =1mx1mx1m
- Volume =$1m^3$
- Density= mass/volume
- Density =$800kg/1m^3$

Density =$800kg/m^3$

3tons/day capacity compost plant

Capacity of box

3 tons/day x 1000kg = 3000 kg/day

Box volume required: 3000kg/day ÷ $800kg/m^3$ = 3.75m3 per day [Considering the Density of Input Waste: 800 kg/m3]

Assuming the fee of 80kg anaimal manure raw materials 30 birr, how much birr need to buy 800kg of raw materials for composting?

Solution = 80kg of raw materials= 30 birr

800kg of raw materials = ?

$$\frac{800kg \times 30 \text{ birr}}{80 \text{ kg}}$$

=300 birr need

Figure: 8.1. Box

Self-Check 8	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. If 120 Qt of compost is needed what will be the volume of pit ? assumption $1m^3$pit give 6Qt of compost?(6)

Answer

Score = _____

Rating: _____

Note: Satisfactory rating – 6 points **Unsatisfactory - below 6 points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Information Sheet-9	Receiving and recording raw material fee

9.1. Record keeping

Maintaining detailed records provides an historical record of the receiving and raw materials fee. Also, good records provide a basis for proper communication with all stakeholders and use periodically evaluating records helps identify where improvements are needed and provides information necessary for making the operation more efficient. A list of records that could be kept is:-

- Raw wastes (solid and liquid) weights and types;
- Amount of compost made/shipped in different forms (buyer/client lists);
- Amount of time required to make the compost (time, material received, placed into windrows, turning frequency);
- Fee of raw materials per tone/kilogram /quantal
- Routine monitoring data;
- Marketing and distribution;
- Permits and approvals;
- Monitoring and testing;
- Accidents;
- Expenses and income;
- Public information and education activities.

Self-Check 9	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. List the important recording raw material fee?(2 points)

Answer

Score = _____

Rating: _____

Note: Satisfactory rating – 2 points **Unsatisfactory - below 2 points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Reference

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2. Central Environmental Authority. 2013. Technical Guidelines on Solid Waste Management in Sri Lanka. Hazardous Waste Management Unit Pollution Control Division.
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Horticultural Crops Production

Level II

Learning Guide-34

Unit of Competence:- Collect Raw Materials for Composting

Module Title:- Collecting Raw Materials for Composting

LG Code: AGR HCP2 M09 LO3-LG-34

TTLM Code: AGR HCP2 TTLM 0120v1

LO3: Remove contaminants and stockpile acceptable raw materials

Instruction Sheet	Learning Guide 34

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

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

- Confirming stockpiling location and arrangement on site
- Identifying,removing and recording physical contaminants of raw materials
- Confirming physical contaminants handling,stockpiling location and arrangement
- Segregating and stockpiling raw materials in appropriate areas
- Monitoring raw material stockpiles
- Labeling raw material stockpiles

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 –

- Confirm stockpiling location and arrangement on site
- Identify,remove and record physical contaminants of raw materials
- Confirm physical contaminants handling,stockpiling location and arrangement
- Segregate and stockpiling raw materials in appropriate areas
- Monitor raw material stockpiles
- Label raw material stockpiles

Learning Instructions:

1. Read the specific objectives of this learning guide.
2. Follow the instructions described below 3 to 4.
3. Read the information written in the information “Sheet 1, 2,3, 4, 5 and 6”.
4. Accomplish the “Self-check 1, 2, 3, 4, 5 and 6” in page -81, 83, 86, 89, 93 and 95 respectively.

Information Sheet-1	Confirming stockpiling location and arrangement on site

1.1. Site security for stockpiling

Some form of access control and site security should be provided to prevent illegal waste dumping and vandalism. Commonly, waste management facilities are enclosed within by barbed-wire or chain-link fencing. Installation of security systems (i.e., building alarms, video cameras) may also be necessary to augment basic security precautions, depending upon the degree of vandalism encountered in the area.

1.2. Confirming stockpiling location and arrangement

1.2.1. Raw materials storing area

A well-defined stornig area should be included in the layout and design of all organics processing facilities. A dedicated area allows for traffic controls that prevent delivery vehicles from entering processing areas and possibly creating safety issues. It also allows for feedstocks to be inspected before they are processed so that potentially harmful, unacceptable materials, such as sharps and large objects, can be removed. Including small, temporary storage space in the storing area provides operations staff with the flexibility to manage surges in feedstock deliveries and preprocessing, as well as processing equipment, in a more consistent manner. Another benefit to providing temporary storage is that feedstock can continue to be received in the event that processing is disrupted for short periods of time (i.e., as a result of equipment malfunction or process upsets). At facilities accessed by roadways subject to traffic congestion, storage provides flexibility to schedule deliveries during off-peak traffic hours, which can help to reduce collection and transfer costs. The size of the receiving area will vary based on the daily capacity of the facility, and the number and types of vehicles delivering feedstock. At a minimum, the receiving area should allow for at least two vehicles to unload materials simultaneously and for material handling equipment to manoeuvre within the storage area at the same time. At larger facilities, it may be necessary to accommodate more than two vehicles at the same time. To help mitigate odours, the size of storage space in the receiving area should be limited to be between one and three days' worth of material. Regardless of the amount of storage provided, operations staff should always strive to process materials the same day it arrives at the facility. If feedstocks will be stored for more than one day, store them on a "first-in, first-out" basis: older feedstocks should not be covered by newer feedstocks or otherwise be inaccessible as new materials are received.

1.2.2. Outdoor storing areas

Ideally, outdoor storing areas should be paved or have some other hard surface (e.g., concrete or lime- or cement-stabilized soil) that can withstand the loads from heavy trucks and wheel loaders. This is, in part, to ensure that the storing area can be accessed during all anticipated weather conditions, and feedstocks can be removed or processed on a regular basis (rather than accumulating and leading to nuisance conditions). The storing area should have a slope of between 0.5 and 2%, and surface water runoff should be captured for treatment. Environmental regulations also often require that outdoor storing areas be constructed overtop an environmental liner (e.g., clay or synthetic material) to protect groundwater resources.

1.2.3. Enclosed storing area

As a result of the potential for some feedstocks (e.g., food waste) to generate odours and/or to attract birds and wildlife, it may be beneficial for the storing area to be partially or fully enclosed within a building. There are a number of building types that can be used, ranging from wood frame and fabric-style buildings, to engineered metal structures. The style of building used is a function of the amount of interior space needed, interior clearance requirements, ventilation design for odour capture, and corrosion protection. Designing the receiving building so that delivery vehicles can be completely indoors with access doors closed when unloading significantly reduces the risk of odour releases. However, this approach does increase the size and cost of the building, particularly if it must be designed to accommodate large tractor-trailer units that are typically used to transport materials from transfer stations. The concept of using two doors to create an “airlock” that delivery vehicles must pass through to enter the receiving building is another means of reducing the risk of odour emissions. However, these types of systems also increase the size and complexity of the building, and its construction cost. Overhead doors that open and close quickly are a recommended feature that should be incorporated into receiving buildings. Whenever the overhead doors are opened, the ability of ventilation systems to prevent odorous air from leaving the building is severely compromised. Using doors that can be opened or closed in 15 seconds or less can help to significantly reduce the impacts on ventilation systems, and also reduce delivery vehicle unloading times. Air curtain technology has become a popular means of balancing structural design and construction costs with the need for odour containment at organic waste processing facilities. An air curtain system consists of a fan and ducting system installed along the top frame of overhead doors.

The system blows air down wards at a high velocity over the entire width of the door opening, and creates an invisible barrier that prevents interior air from leaving and exterior air from entering. Some facility operators also claim that the high-velocity air current also deters birds from entering the facility through open doors. Floors within enclosed receiving areas are normally constructed of concrete, although it may be feasible to use asphalt. In either case, the floors should be sloped away from doors so that any leachate that escapes from feed stocks is contained within the building. Floor drains can collect leachate and direct it to storage tanks, but drains are prone to clogging and can become an ongoing maintenance issue. Absorbing leachates with dry feed stocks, wood chips, or compost, and then composting the absorbent may be a preferable method of managing leachate.

1.2.4. Amendment storage area

The amendments typically used at municipal processing facilities, such as straw, wood chips, and sawdust, are normally high in carbon and have a low moisture content, and can be stored outdoors without producing odours. However, it may be necessary to provide some type of containment or enclosure to prevent these amendments from getting wetted by precipitation or carried away by strong winds. Depending upon climatic and hydrogeological conditions, providing a liner system under amendment storage areas to prevent ground water impacts may be necessary. Local building codes and by laws may contain specific requirements, including maximum pile heights, and volumes and separation distances between piles. The need for fire detection and sprinkler systems must also be considered and incorporated into facility design.

1.2.5. Compost curing area

At facilities that use enclosed or in-vessel composting technologies, curing activities normally take place in a separate, outdoor area. At out door composting facilities, curing often takes place at the same location as active composting for convenience and to reduce material handling requirements.

When curing and active composting areas are separated, they should be located up-slope so that drainage from receiving and active processing areas does not flow into or through the curing area. Like out door receiving areas, the working surface in outdoor curing areas should be designed to meet the expected wear and tear from site equipment, including wheel loaders and trucks. Although concrete and asphalt are the most desirable working surfaces, their capital costs can be prohibitive. Therefore, curing pads are often constructed of gravel, crushed concrete, lime- or cement-stabilized soil, or asphalt millings.

Clay working pads covered with a layer of topsoil or wood chips have also been used. Curing areas are most often underlain by a clay or synthetic liner system for ground water protection. Curing pads should also have a slope of between 0.5 and 2% to promote drainage. It is important to ensure that windrows and piles are oriented in the same direction as the pad's slope to prevent blocking the flow of runoff and leachate draining from one pile into an adjacent pile.

1.2.6. Finished compost storage area

Finished compost should be stored away from operating areas so that it is not contaminated by incoming feedstocks or surface water runoff from active composting and curing pads. Ideally, the product storage area is also easily accessible by customers; they should not have to drive through operating areas to access the storage area, as this increases safety risks. The storage area should have graded surfaces (e.g., sloped at 0.5 to 2%) that promote drainage and prevent water from ponding, which can raise the product's moisture content (and affect sales efforts) and/or result in anaerobic conditions and odours. The product storage area should also have a working surface consisting of a strong sub-base and base material that is able to support the weight of wheel loaders and trucks without rutting. Large ruts can limit vehicle access and can lead to further water ponding. The size of product storage areas is a key consideration and is normally determined by the facility's production cycle and the demand for compost over the year. Consider the following when designing storage areas: Market cycle information (i.e., howmuch product is sold during each monthof the year), in combination with thefacility's anticipated monthly or weeklyproduction output, is used during thefacility design stage to determine storage requirements. The form in which products are soldaffects storage space requirements.When compost products are soldin bulk, they can be stored in large stockpiles that maximize spaceutilization. However, if products are bagged and palletized, the amount ofrequired space increases significantly since pallets holding bagged compost can not be stacked.

1.2.7. Additional infrastructure requirements

Depending upon the site and location of the processing facility, there may be additional infrastructure required. If the processing facility is located at an existing waste management facility (e.g., landfill or recycling centre) or public works yard, it may be possible to share existing infrastructure.

Self-Check 1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Write the important of site security for stockpiling?(2 points)
2. Define raw materials storing area?(2 points)
3. Define Residuals storage areas?(2 points)

Answer

Score = _____

Rating: _____

Note: Satisfactory rating – 6 points **Unsatisfactory - below 6 points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Identifying, removing and recording physical contaminants of raw materials

2.1. Identifying physical contaminants

Contamination of composting by different physical contaminants;-

- Chemicals of both synthetic and natural origin
- Metal cans,
- Glass bottles
- Plastic film
- Inorganic materials (e.g., asbestos), and organometallics.
- Allergens from household and yard wastes.
- Corrosive, caustic, explosive and sharp materials.
- Eucalyptus,
- Fuel (kerosene, diesel, petrol),
- Engine oil & stones
- Any pieces of clothes
- Hyena cat and dog droppings
- Crops treated by chemical pesticides(up to 6 months)
- Avoid use of torn or spin trees branches leaves
- Any type of wax, any type of fat, hide/skin & etc.
- Weed seed

2.2. Removing and recording physical contaminants of raw

General requirement, every worker must ensure that regular inspections are made of all raw materials and chech weather physically contaminants or not, then sorting contaminat raw materials from non-contaminant and properly remove or dispose all physical contaminants. Recording unsafe conditions whenever a person observes what appears to be an unsafe or harmful condition or act the person must report it as soon as possible to a supervisor or to the employer, and the person receiving the report must investigate the reported unsafe condition or act and must ensure that any necessary corrective action is taken without delay. If emergency action is required to correct a condition which constitutes an immediate threat to workers only those qualified and properly instructed workers necessary to correct the unsafe condition may be exposed to the hazard, and every possible effort must be made to control the hazard while this is being done.

Self-Check 2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. List and discuss physical contaminants of raw materials?(2 points)

Answer

Score = _____

Rating: _____

Note: Satisfactory rating – 2 points **Unsatisfactory - below 2 points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Information Sheet-3	Physical contaminants handling, stockpiling location and arrangement

3.1. Physical contaminants (residuals) storage areas

Where possible, residuals should be removed during the feedstock recovery and pre-processing stages so that the quality of finished products is not impaired. Once these unacceptable materials are removed, they should be stored in roll-off containers, in concrete lock-block bunkers, or through some other means that prevents litter. The size of containers and bunkers should be chosen to prevent more than two or three days' worth of material from accumulating; this forces a frequent disposal schedule and helps to prevent odours.

3.2. Leachate and effluent handling Infrastructure

Leachate is the highly contaminated liquids that drain from feedstock stockpiles, active composting and curing piles, and residual piles. Effluents may also be generated within processing tanks and vessels. Proper control and management of leachate is necessary to prevent releases of harmful substances to the environment that could result in adverse effects. Designers and operators should focus on separating leachates into low-strength (i.e., less contaminated) and high-strength (i.e., more contaminated) leachate. This allows for more flexibility in treatment and disposal options; it is generally more cost-effective to treat smaller volumes of a high-strength leachate than larger volumes of low- to moderate-strength leachate.

3.3. Contaminated storm-water management infrastructure

Contaminated storm-water includes surface water runoff and roof drainage that has come in contact with leachate, feedstocks that are stored or processed outdoors, and residuals. Since it has the potential to contain contaminants, this runoff needs to be managed to prevent environmental impacts. It is a good practice to assume that any stormwater runoff from outdoor feedstock and amendment receiving (and storage) areas, processing areas, and residual storage areas is contaminated, so design and operate the facility accordingly. Capture and collection of contaminated stormwater requires some combination of site grading, swales, ditches, curbs and gutters, and catch basins. If catch basins are to be used, consideration should be given to sediment and debris traps, since there is a higher likelihood that material will accumulate in the catch basins and associated underground lines. Contaminated stormwater is generally collected in retention ponds where it can be tested prior to being released. At a minimum, these design ponds should be capable of managing the flow from a 1-in-25-year, 24-hour storm event. Lining retention ponds with engineered

clay liners or synthetic materials to prevent seepage and possible ground water impacts is a common requirement. It may also be beneficial to aerate the ponds with pumping systems or paddle wheels to reduce the levels of biodegradable organic contaminants in the stormwater. Reusing contaminated storm-water within the composting processes is a wide spread practice that is used to minimize the need for using potable water in processing operations.

Self-Check 3	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Define Leachate?(3 points)
2. Where unacceptable materials should be stored? (3 points)
3. Discuss contaminated storm-water management? (3 points)

Answer

Score = _____

Rating: _____

Note: Satisfactory rating – 9 points **Unsatisfactory - below 9 points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Information Sheet-4	Segregating and stockpiling raw materials in appropriate areas

4.1. Segregating of raw materials

Segregating raw materials refers to the practice of avoiding the mixing certain types of waste by discarding them into different containers. For example, biodegradable waste could be discarded into one container (to provide a good feedstock for composting) and other wastes could be put into a different container, to be collected and treated differently. This is done in such a way that the materials are never mixed. At source segregation needs to be done at household level and needs significant efforts in awareness raising and education.

Segregating and stockpiling raw materials in appropriate areas			
Suitable for composting	Not suitable for composting		
❖ Biodegradable materials: ✓ Garden waste ✓ Leaves and grass ✓ Twigs Food waste ✓ Vegetables & fruit waste ✓ Leftover bread Others ✓ Scrap paper/ cardboard ✓ Straw of crop ✓ Chaff ✓ Grass	❖ Hazardous materials: ✓ Cleaning products ✓ Automotive products ✓ Pesticides ✓ chemicals and ✓ inflammable product ✓ Used razor blades ✓ Syringes ✓ Broken glass ✓ Screws ✓ nails ✓ Expired medicines ✓ Batteries ✓ Treated timber etc.	❖ Residues: ✓ Soiled ✓ Polythene ✓ Hard leaves ✓ Tree branches ✓ Coconut shells ✓ Bones ✓ Painted wood ✓ Boards etc.	❖ Recyclables: ✓ Metal ✓ Aluminum ✓ Cardboard ✓ Paper ✓ Plastic ✓ scraps ✓ Glass
Composting Process		Transport to Landfill Site	Sell to recycling Industry

Figure:4.1. Segregation of compost raw materials

4.2. Stockpiling raw materials

Sorting of incoming waste

- As soon as the household waste arrives at the composting site, it is separated manually into biodegradable material, recyclables, and rejects.
- Manual sorting can be done in different ways, including on the ground with a small rake. Workers must wear protective gloves, boots and masks, as they are in close contact with the waste.
- Rejects and recyclables are sorted into different buckets and/or baskets.
- Recyclables are stored for sale in a shed.
- Rejects are either disposed of in nearby municipal waste bins or temporarily stored on-site before being transported to the landfill.
- The biodegradable waste fraction is further processed inside the plant.
- After having finished the sorting process, the sorting platform is cleaned.
- No waste should remain overnight on the sorting platform as it can attract vermin and cause smells.
- Which materials can be sold as recyclables depends on the local market. In most cases, at least, a market for paper and cardboard already exists. In other cities, industries processing of glass, plastic or aluminum can be found.
- Check the local market for prices and retailer networks. Generally, industries only accept bulk delivery. If space is limited, it might be more suitable to find a reliable middleman instead of storing large amounts of recyclables at the composting site.

Self-Check 4	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Difine Segregating of raw materials?(2 points)
2. List the importance of sorting raw materials(2 points)

Answer

Score = _____

Rating: _____

Note: Satisfactory rating – 4 points **Unsatisfactory - below 4 points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Information Sheet-5	Monitoring raw material stockpiles

5.1. Develop a protocol for monitoring material stockpiles

In order to maintain an efficient operation and develop a safe, attractive product, you should regularly track the volume of incoming waste, the temperature and, possibly, the oxygen content of the piles, as well as evaluation of any odor generation. Perform an initial and regular follow-up analyses of the compost produced, including tests for contaminants and the compost's nutrient value. The data will help you evaluate the success of your operation and decide whether to alter your process. Also, it will provide information that will be requested from potential end users. While carrying out composting activities, quality control of the compost needs to be ensured by regular laboratory tests of incoming waste and final product compost.

5.2. Monitoring the process

The identification and evaluation of pertinent operational parameters and their bearing on the compost process are essential elements in the development of an effective monitoring program. The attainment of these elements and understanding of their underlying principles can be greatly facilitated by a thorough knowledge of the sequence of events that takes place during the composting process when all conditions are satisfactory. Certain features of the course of the compost process can fill this role and serve as parameters in the monitoring of system performance. Three prominent features are: 1) temperature rise and fall, 2) changes in physical characteristics (odour, appearance, texture) and 3) particle size.

- **Temperature rise and fall**

The temperature of the material to be composted begins to rise shortly after the establishment of composting conditions, i.e., after the material has been windrowed or has been placed in a reactor unit. The initial change in temperature parallels the incubation stage of the microbial populations. If conditions are appropriate, this stage is succeeded by a more or less exponential rise in temperature to 60° to 70°C. The exponential character of the temperature rise is a consequence of the breakdown of the easily decomposable components of the waste (e.g., sugars, starches, and simple proteins). It is during this period that the microbial populations increase exponentially in population size. The temperature remains at this level (plateaus) over a period of time that is determined by the system used and the nature of the waste. There after, the temperature begins to drop gradually until it

reaches the ambient level. The duration of the high-temperature plateau may be prolonged if the substrate is largely refractory, or if conditions are less than satisfactory. It should be noted that the magnitude or intensity of the rise is much reduced if the wastes have a significant concentration of inert material. Such a condition would be indicated by a low volatile solids concentration (e.g., tertiary municipal sludge). In these cases, the temperature level probably would be lower, i.e., in the 50° to 60°C range. If any other condition is less than satisfactory, the results would also be a prolonging of the duration and a reduction of the level of the high-temperature plateau. Bacterial activity becomes less intense and the resulting temperature drops after the readily decomposable components have been degraded, and only the more refractory components remain. Consequently, it may be assumed in routine compost practice that by the time the temperature has descended to ambient or a few degrees above, the more biologically unstable components have been stabilised and, therefore, the material is sufficiently composted for storage or for utilisation. Although heat generated in the compost process is a result of microbial metabolism, the accumulation of the heat energy also depends upon the effectiveness of the insulation provided by the composting mass. In short, the characteristic rise in the temperature is a measure of the heat generated in microbial metabolism and retained within the composting mass. Thus, two factors are responsible for the temperature rise -- namely, heat generated by the microbial population and the effectiveness of the thermal insulation provided by the compost mass and by any cover or container enclosing the mass. Effectiveness of the insulation is partly a function of the size of the composting mass. In areas in which the ambient temperature is higher than about 8° to 10°C, the minimum volume for heat accumulation is about 1 m^3. The maturation stage or phase is indicated by the onset of a persistent decline in temperature and other indicators of microbial activity despite the absence of limiting factors, i.e., maintenance of optimum conditions. In short, it coincides with the approaching completion of the compost process and resulting increase in stability. Past experience indicates that the compost mass can be safely used or stored after the temperature has finally dropped to about 40°C.

- **Changes in physical characteristics**
  - ✓ **Appearance**

Provided that the process is progressing satisfactorily, the composting mass gradually darkens and the finished product usually has a dark grey or brownish colour.

- ✓ **Odour**

An assortment of odours replaces the original odour of the substrate within a few days after the start of the process. If the process is advancing satisfactorily, the succeeding odours probably could be collectively described as “faint cooking”. However, if conditions are unsatisfactory (e.g., anaerobiosis), the predominant odour would be that of putrefaction. If the C:N of the substrate is lower than about 20:1 and the pH is above 7.5, the odour of ammonia could become predominant. An earthy aroma is characteristic of the curing and maturing stages.

- ❖ **Particle size**

Because of abrasion by the other particles and of maceration, the particle size of the substrate material becomes smaller. Additionally, decomposition renders fibres brittle and causes amorphous material to become somewhat granular.

Self-Check 5	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. List prominent features that must be considered in composting process?(2points)
2. Discuss temperature rise and fall in composting operations?(2points)
3. List physical characteristics that must be considered in compost preparation?(2points)
4. Discuss the characteristic odors of different stages of composting?(2points)

Answer

Score = _____

Rating: _____

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

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Information Sheet-6	Labeling raw material stockpiles

6.1. Labeling raw material stockpiles

- **Labeling**

Labeling raw materials stockpiles is important to keep clear records of what you do for a number of reasons:- you may be carrying out sorting and segregating raw materials in differenent catagories by doing labeling and you may be carrying out rejecting and disposing unacceptable raw materials easly by doing labeling. During labeling the following point should be clearly mension

- stockpiles name
- supplier information
- A guarantee of the minimum quantity of OM and the maximum moisture content of the product
- Nutrient grade (e.g., concentration of nitrogen, phosphorus, and potassium in the product) if any type of nutrient value claim is made or implied
- Directions for use and cautionary statements

There are further protocols for label sizes and fonts, as well as an extensive set of rules surrounding claims that can and cannot be made on the label. The label must also provide a lot number for the product in the event that a product recall is required. To make sure everyone understands clearly about what's involved, a job sheet or work order should contain information about:-

- Name of company or service providers
- Address.
- Cost/price
- Area to be used
- The odour content of raw materials on receipt
- Method of receival and storage of raw materials
- Method of mixing of raw materials
- Mix ratios of raw materials
- Management and monitoring of the composting process.
- Management and monitoring of the curing process.
- Screening of fresh composts.

Self-Check 6	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers

1. What is the importance of labeling raw material stockpiles?(1point)
2. What information labeling on raw material stockpiles?(1point)

Answer

Score = _____

Rating: _____

Note: Satisfactory rating – 2 points **Unsatisfactory – below 2 points**

You can ask your teacher for the copy of the correct answer

Name: _____ Date: _____

Short Answer Questions

Reference

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2. “Composting Yard Trimmings and Municipal Solid Waste” (1994) by U.S Environment Protection Agency (EPA), Office of Solid Waste and Emergency Response.

3. Eawag/Sandec and Waste Concern. 2006. “Decentralized Composting for Cities of Low- and Middle-Income Countries.” A Users’ Manual.

4. “Modern Composting Technologies”, (2005) Edited by the staff of BioCycle, a Journal of Composting & Organic Recycling, Emmaus, PA 18049, USA.

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Profile of trainers participate on special Horticultural Crop Production TTLM development for level II at Adama 2020