Method of Composting Organic Waste at Floating Village in Ha Long Bay

The method of composting explained in this material is to decompose organic waste by microorganisms, mainly aiming at reducing and stabilizing organic waste.

1. Basic procedure of composting (daily work)

The basic procedure of composting is;

1) Mix organic waste into a compost pile, and
2) Turn and stir the compost pile thoroughly and rebuild the pile, every day.

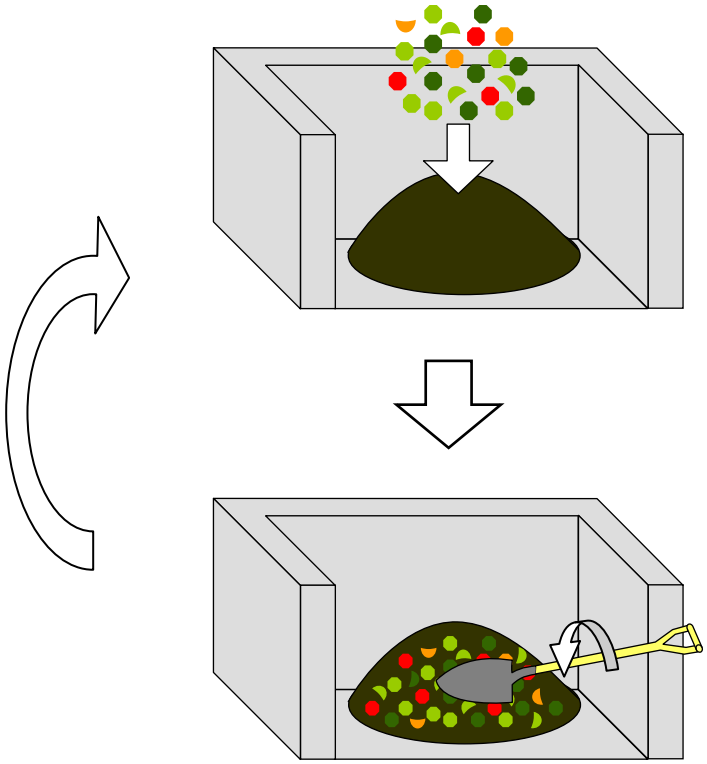


Fig. 1: Basic procedure of composting (daily work)

2. Wastes suitable for composting

O Basically, organic wastes are suitable for composting, such as:
- Food waste (thức ăn thừa)
- Fruit peel (vỏ hoa quả)
- Tea leaves (bã chè/bã trà)
- Coffee (cà phê)
- Leaves (lá cây)
- Flowers (hoa)
- Vegetables (rau)
- Fruits (quả)
  etc.

(Source: Hanoi URENCO & JICA 3R Project)

■ When organic wastes are mixed into the compost pile, it is recommended that the organic wastes should be chopped into small pieces before mixed. Because, small pieces are easily decomposed but large pieces need longer time for compete decomposition.

■ When leaves/grasses floating on the sea surface are collected and mixed in the compost pile, it is recommended to wash the leaves/grasses with fresh water (rainwater, etc.) before mixed, in order to reduce salinity contained in the leaves. Because, if the compost has a high salt content, it is not appropriate to use such compost to grow plants, vegetables, fruits and flowers aftewards.

✖ Inorganic wastes are not suitable for composting and should not be mixed in the compost pile.

- Animal bones (chicken, pig, cow) (xương động vật)
- Shells (vỏ sò, vỏ hến)
- Tree branches (cành cây)
- Coal ash (xỉ than)
- Firewood (củi khô)
- Cigarette butts (mẩu thuốc lá)
- Old clothes (quần áo cũ)
- Plastic bags (túi nilon)
- Pottery and ceramics (sành sứ)
- Glass and glassware (thuỷ tinh)
- Toys (đồ chơi)

(Source: Hanoi URENCO & JICA 3R Project)

■ As for bones and shells,

○ Fish bones, shrimp shells, prawn shells, crab shells and egg shells are appropriate for composting. But, it is recommended to chopping them into small pieces before mixing them into the compost pile, to facilitate their faster decomposition.

✖ Chicken bones, pig bones, cow bones and shellfish shells are not appropriate for composting. Therefore, they should not be mixed in the compost pile.

■ As for ashes,

○ Paper ash and wood ash are appropriate for composting and can be mixed in the compost pile.

✖ Coal ash is not appropriate for composting. Therefore, they should not be mixed in the compost pile.

■ As for oil,

○ Waste cooking oil is suitable for composting and can be mixed in the compost pile.

✖ Gasoline, kerosene, machine oil, grease and lubricant should not be mixed in the compost pile.

3. Why the compost pile must be turned and stirred every day?

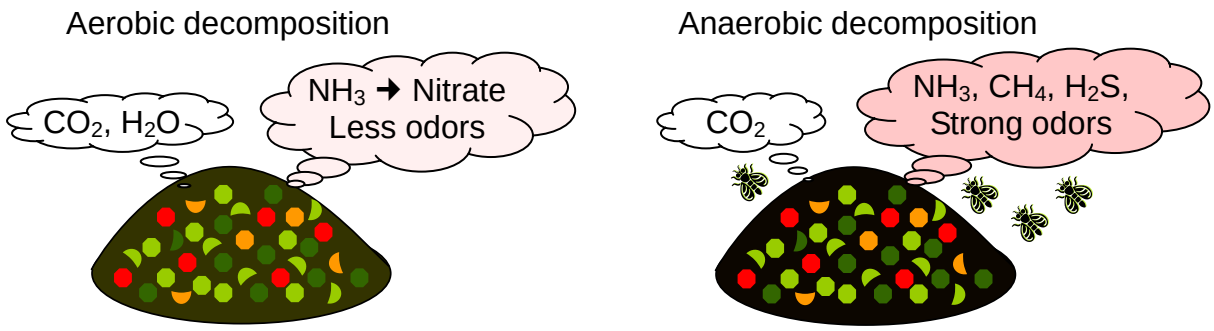
Composting a process where organic wastes are decomposed by the activity of microorganisms, such as bacteria and fungi. Organic waste decomposition by microorganisms can be carried with air (oxygen) (called "aerobic decomposition"), or without air (oxygen) (called "anaerobic decomposition").

Aerobic decomposition has advantages, as compared to anaerobic decomposition (see the table below), such as rapid decomposition rate (speed), less smells and odors, less nuisance insects, etc. For this reason, aerobic decomposition is recommended.

In order for aerobic decomposition to take place, enough air (oxygen) needs to be mixed into compost piles. Therefore, turning and stirring compost piles are required in order to allow air to enter in the compost piles. It is recommended to turn and stir compost piles once a day.

Comparison aerobic decomposition and anaerobic decomposition

	Aerobic decomposition	Anaerobic decomposition
Condition	In the presence of air (oxygen)	In the absence of air (oxygen)
Microorganism	Aerobic microorganisms	Anaerobic microorganisms
Water content	40% - 60%	More than 60%
Features	- The decomposition rate (speed) is fairly high. - The composting process produces less smells and odors. - The composting process produces heat. The heat helps to accelerate the composting process, and to kill insect eggs and reduce nuisance insects.	- The decomposition rate (speed) is rather slow. - The composting process produces strong bad smells and odors. - The composting process does not produce heat. - Compost piles naturally attract nuisance insects. Some methods are required to prevent and control nuisance insect.
Method	- Turning and stirring are needed to allow enough air to enter in the compost piles.	- Sealed containers or vessels are required to keep anaerobic conditions as well as to prevent odors and insects.



Comparison aerobic decomposition and anaerobic decomposition

Turn and stir compost pile well!!
(Source: IGES Kitakyushu organic waste composting manual)

4. Control of water content of the compost pile

In the composting process, it is important to maintain the water content of the compost pile at proper level, in order for microorganisms to live and work to decompose organic wastes.

- If the compost pile is too dry, the microorganisms cannot grow nor survive in the compost pile, and stop decomposition activities.
- However, if the compost pile is too wet, the supply of air (oxygen) to the inside of compost pile is restricted, then the compost process becomes anaerobic due to a lack of oxygen and offensive odors will arise.

Proper water content of the compost pile is 40-60% by weight.

■ Hand squeeze test

Here is a simple way to check the water content of the compost pile.
First, take a handful of compost from the center of the pile in your hand and squeeze it tight into a ball.

(a)

- If water drips or trickles out from between your fingers, the compost pile is too wet.

(b)

- If no water drips out but the ball crumbles and falls apart when open your hand, the compost pile is too dry.

(c)

- If no water drips out and the ball hold its shape when open your hand, the compost pile has the proper water content.

(Source: IGES Kitakyushu organic waste composting manual)

■ **When the compost pile is too dry**

If the compost pile is too dry, sprinkle fresh water (rain water, not sea water) over the compost pile and turn and stir the pile well enough, so as to make the water content uniform in the pile. When sprinkling water, please add water little by little and carefully check the water contents by the "hand squeeze test", not to make the compost pile too wet.

■ **When the compost pile is too wet**

In fact, if the compost pile becomes too wet, there is no way to reduce the water contents except evaporating the excess water content or adding dry organic materials such as dead leaves, dried grass.

Therefore, it is recommended to control the water content of the compost pile at lower level, in order to avoid too wet conditions.

In addition, it is necessary not to let the compost pile get wet in the rain. In order to avoid the compost pile get wet in the rain, the pile may be covered with a plastic sheet loosely weighted down at the sides, so as to allow air flow into the compost pile.

When sprinkling water, be careful not to add too much water!!

(Source: IGES Kitakyushu organic waste composting manual)

5. How to check the completion of composting

There are several indicators to tell you when composting is finished.

- The compost material has a dark brown color.
- The compost material is crumbly, loose, and humus-like.
- The compost material has earthy smell.
- All the compost materials are completely converted into soil-like material (called "humus") and there is no trace of food scraps, leaves and grass, except woody materials like twigs and sticks.
- The compost pile has shrunk to about 1/3 of its original volume.

6. When the decomposition rate is slow

When it is observed that the decomposition rate slows down, it is recommended to mix the following items into the compost pile, in order to increase microorganism in the compost pile and accelerate their decomposition activity.

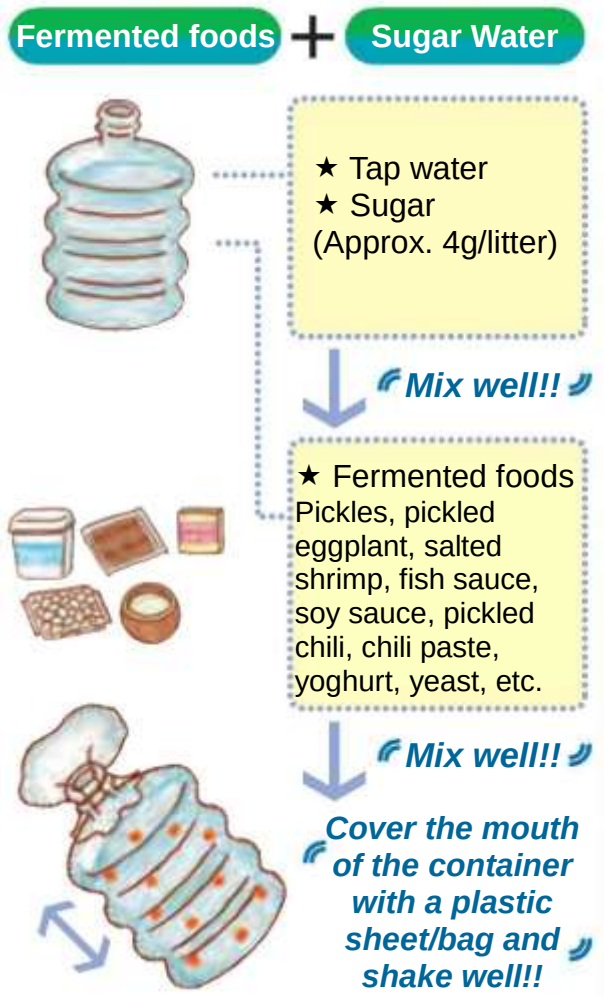
- Leaf mold, fallen leaves, dead leaves, dried grasses, collected at forests, parks, gardens, other green areas, etc.
- Rice bran and rice husk
- Seed compost produced at the compost plant on land (Công ty cổ phần xử lý chất thải Hạ Long)
- Fermentation accelerating liquid (refer to below for details)

These items naturally contain a large number of various kinds of microorganisms involved in aerobic decomposition. Therefore, adding these items helps to increase aerobic microorganisms in the compost pile.
When adding these items;
1) Turn and stir the compost pile well enough so as to the added items are spread in the pile uniformly and to allow enough air in the pile.
2) Check the water content carefully not to make the compost pile too wet.

■ How to make "fermentation accelerating liquid"

A. Fermented foods mixed in sugar water

1) Add sugar in tap water (approx. 4g/litter) in a container.
2) Mix well.
3) Cut fermented food into small pieces.
   Examples of fermented food:
   - Pickles (dưa muối)
   - Pickled eggplant (cà muối)
   - Salted shrimp (mắn tôm)
   - Fish sauce (nước mắm)
   - Soy sauce (nước tương)
   - Pickled chili (mắm chàm)
   - Chili paste (tương ớt)
   - Yoghurt
   - Yeast, etc.
4) Mix fermented food in the sugar water.
5) Mix well.
6) Cover the mouth of the container with plastic bag/sheet to prevent insect from entering in the container.
7) Leave the liquid as it is for 3 to 5 days.
8) If the liquid has sweet and sour smell as well as alcohol smell, the fermentation accelerating liquid is ready for use. (This is the sign of a good fermentation result.)



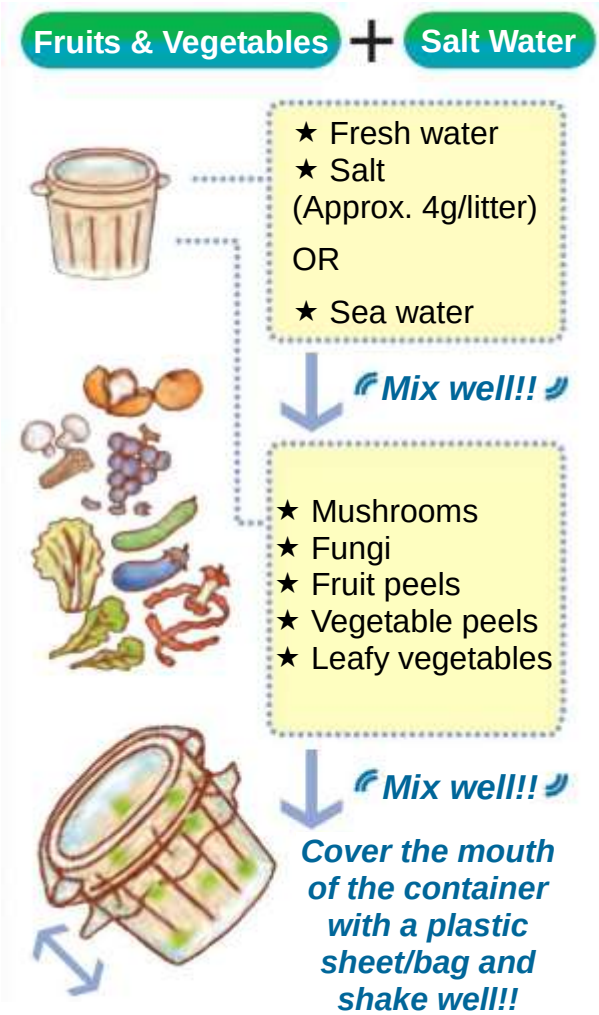
(Source: IGES Kitakyushu organic waste composting manual)

B. Fruits & vegetables mixed in salt water

1) Add salt in fresh water (approx. 4g/litter) or put sea water in a container.
2) Mix well.
3) Cut mushrooms and fungi, fruit peels, vegetable peels, leafy vegetables into small pieces.
   Mushrooms and fungi
   Fruit peels
   - Grape peels
   - Lime peels
   - Orange peels
   - Apple peels
   - Mango peels
   - Papaya peels
   - Longan peels
   - Watermelon peels

   Vegetable peels
   - Eggplant peels
   - Cucumber peels
   - Pumpkin peels

   Leafy vegetables
   - Cabbages
   - Lettuces
   - Water spinaches (rau muống)
   - Herbs (rau thơm), etc.
4) Mix fruits and vegetable in the salt water.
5) Mix well.
6) Cover the mouth of the container with plastic bag/sheet to prevent insect from entering in the container.
7) Leave the liquid as it is for 3 to 5 days.
8) If the liquid has <u>sweet and sour smell</u> as well as <u>alcohol smell</u>, the fermentation accelerating liquid is ready for use.
   (This is the sign of a good fermentation result.)



(Source: IGES Kitakyushu organic waste composting manual)

Note:
- If the liquid has <u>spoiled smell</u> or <u>rotten smell</u>, you <u>failed</u> in making the fermentation accelerating liquid. Please dispose it and try once again.
- Gas (carbon dioxide gas) is generated from the liquid during the process and the sealing plastic sheet/bag may be swollen. This is not a sing of failure.

Reference:
- Fermented foods are containing aerobic microorganisms and are not contaminated by anaerobic bacteria. Therefore, sugar water is used for growing aerobic microorganisms contained in fermented foods.
- On the surface of mushrooms, fungi, fruit peels, vegetable peels and leafy vegetables, there exists a large number of anaerobic bacteria together with aerobic microorganism. Therefore, salt water is used to kill anaerobic bacteria on the surface of fruits and vegetables, etc.

Various kinds of microorganisms are involved in composting process

Composting process is not completed by only one kind of microorganisms. There are various kinds of microorganisms involved in the composing process.
The following main three groups of microorganism are playing important roles in the composting process.

- Bacteria
Bacteria (such as molds, yeasts, lactic acid bacteria, grass bacillus, etc.) decompose easily degradable organic matters. These kinds of bacteria are so much contained in fermented foods.
- Actinomycete
Actinomycetes play a role in decomposing cellulose and fibrous materials (such as mid-rib of leaves, plant stems and stalks, peels of fruits and vegetables, etc.) Actinomycetes are often attached to leaf mold, fallen leaves, dead leaves, dried grasses.
- Fungi
Fungi decompose play an important role in decomposing tough organic matter, such as lignin and other woody material.

For successful composting, it is important that a large number of various aerobic microorganisms are grown in the compost piles.

7. How to use compost

The matured compost, in which decomposition is completely finished, can be used for planting trees, flowers and vegetables.
However, please be careful about the following matters.

1) Use compost completely finished and matured
- If compost is not matured enough, decomposable organic matter is still remaining in the compost. Accordingly, microorganisms living in soil will start decomposition activity using the organic matter in the compost, and generate carbon dioxide, ammonia gas and organic acid.
- Therefore, please use completely finished compost when using for plants.

2) Do not let compost touch plant roots directly
- In the finished compost, microorganisms are still remaining. When microorganisms carry out decomposition activity, microorganisms generate carbon dioxide, ammonia gas and organic acid, which damage plant roots and kill the plants.
- Therefore, when using compost for plants, please be careful not to let compost touch plants roots.

3) Be careful of the salt level of finished compost
- Floating leaves and grasses collected from the sea contain high levels of salt. If such organic wastes are used for composting, the salt level of the finished compost is rather high, and not good for using for plants.
- When using compost, at first, please add compost for plants little by little and check if the plants are not damaged.