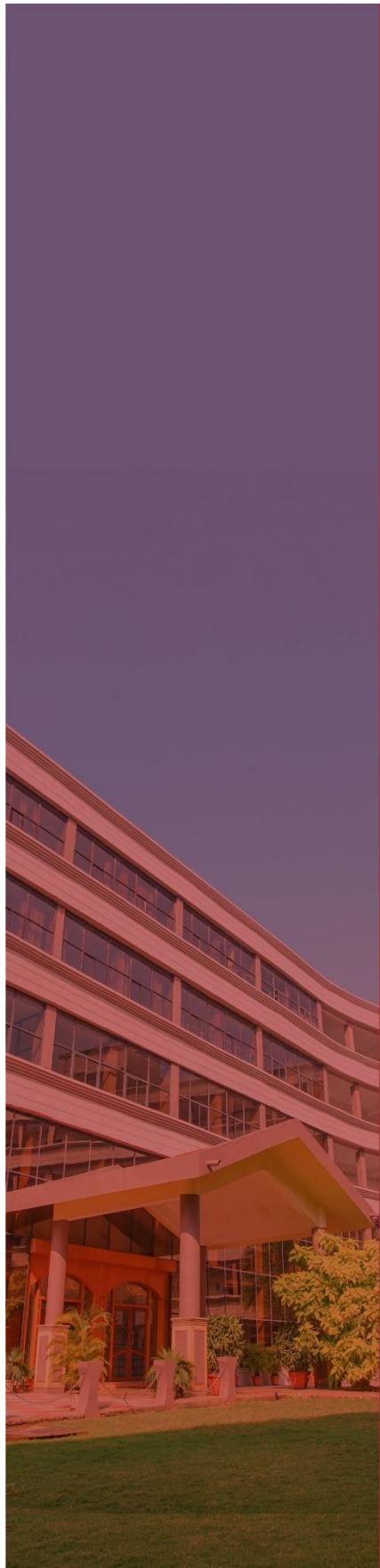


**D.Y. PATIL EDUCATION SOCIETY**  
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STANDARD OPERATING PROCEDURE (SOP)

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# COMPOSTING





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STANDARD OPERATIVE PROCEDURES FOR COMPOSTING

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**STANDARD OPERATIVE PROCEDURES FOR COMPOSTING**

**INTRODUCTION**

The organic content of Municipal Solid Waste (MSW) tends to decompose leading to various smell and odor problems. It also leads to pollution of the environment. To ensure a safe disposal of the MSW it is desirable to reduce its pollution potential and several processing methods are proposed for this purpose. Composting process is quite commonly used and results in production of a stable product - compost which depending upon its quality can be used as a low grade manure and soil conditioner. The process results in conservation of natural resources and is an important processing method, especially in agricultural and horticultural areas.

**PRINCIPLES OF COMPOSTING – MANUAL AND MECHANIZED METHODS**

Decomposition and stabilization of organic waste matter is a natural phenomenon. Composting is an organized method of producing compost manure by adopting this natural phenomenon. Compost is particularly useful as an organic manure which contains plant nutrients (Nitrogen, Phosphorus and Potassium) as well as micro nutrients which can be utilized for the growth of plants (Gotaas 1956). When used in conjunction with chemical fertilizers optimum results are obtained. Composting can be carried out in two ways i.e., aerobically and anaerobically. During aerobic composting aerobic microorganisms oxidize organic compounds to Carbon dioxide, Nitrite and Nitrate. Carbon from organic compounds is used as a source of energy while nitrogen is recycled. Due to the exothermic reaction, the temperature of the mass rises. During the anaerobic process, the anaerobic microorganisms, while metabolizing the nutrients, break down the organic compounds through a process of reduction. A very small amount of energy is released during the process and the temperature of composting mass does not rise much. The gasses evolved are mainly Methane and Carbon dioxide. An anaerobic process is a reduction process and the final product is subjected to some minor oxidation when applied to land.

We at **D.Y.Patil Medical College, Research Institute, Kolhapur** follow the “**NADEP METHOD**” for Composting.

This method was developed by Gandhiwadi farmer Narayan Devrao Pandaripande with his experiments in farming.

We have built a trench 10x6x3 feet brick construction keeping intermittent gaps between bricks.

We collect 1 to 2 tons of hay, green leaf waste, 100 kg cow dung and clean soil.

Lower portion is spread with cow dung, Hay sticks, garden waste surrounded about 6 inches is spread with 100 liter water and mixed with 4 to 5 kg cow dung.

After this procedure we spread clean soil on it with water sprinkling.

Within 3 to 4 months fine compost is ready.

We practice this compost method because it is

- 1) Easy to prepare at college garden site
- 2) All organic waste material is recycled in this compost.
- 3) Very low cost is required to generate.
- 4) Soil became more fertile due to use of compost.
- 5) Soil retention capacity increases.

## **FACTORS AFFECTING THE COMPOSTING PROCESS**

**Organisms** Aerobic composting is a dynamic system wherein bacteria, actinomycetes, fungi and other biological forms are actively involved. The relative preponderance of one species over another depends upon the constantly changing food supply, temperature and substrate conditions. Facultative and obligate forms of bacteria, actinomycetes and fungi are most active in this process.

In the initial stages mesophilic forms predominate and thermophilic bacteria and fungi soon take over except in the final stage of composting. Except when the temperature drops, actinomycetes and fungi are confined to 5 to 15 cm outer surface layer. If the turning is not carried out frequently the actinomycetes and fungi in these layers register increased growth imparting its typical grayish white color. Thermophilic actinomycetes and fungi are known to grow well in the range of 45 to 60o C.

Different organisms are known to play predominant roles in breaking down different constituents of municipal solid waste. Thermophilic bacteria are mainly responsible for the breakdown of proteins and other readily biodegradable organic matter. Fungi and actinomycetes play an important role in the decomposition of cellulose and lignin. The actinomycetes common in compost are *Streptomyces* sp. and *Micromonospora* sp. the latter being more prevalent.

The common fungi in compost are *Thermonomyces* sp., *Penicillium dupontii* and *Aspergillus fumigatus*. Majority of these organisms responsible for composting are already present in municipal solid waste. Not much information is available regarding the organisms active in anaerobic composting, though many of the organisms responsible for anaerobic decomposition of sewage sludge will be active here also, and differences are expected due to the concentration of nutrients present and the temperature conditions.

**Moisture** The moisture tends to occupy the free air space between the particles. Hence, when the moisture content is very high, anaerobic conditions set in. However, the composting mass should have a certain minimum moisture content in it for the organisms to survive. The optimum moisture content is known to be between 50 to 60 % .

**Temperature** The aerobic decomposition of a gram mole of glucose releases 484 to 674 kilo calories (kcal) energy under controlled conditions, while only 26 kcal are released when it is decomposed anaerobically. Municipal solid waste is known to have good insulation properties and hence the released heat results in increase in temperature of the decomposing mass. As some of the heat loss occurs from the exposed surface, the actual rise in temperature will be slightly less. When the decomposing mass is disturbed, as during turning of windrows, the resultant heat loss results in drop in temperatures. Under properly controlled conditions temperatures are known to rise beyond 70oC in aerobic composting. Under properly controlled conditions temperatures are known to rise beyond 70oC in aerobic composting. During anaerobic composting as the released heat is quite small and as part of it is lost from the surface only a marginal rise in temperature occurs. This increased temperature results in an increased rate of biological activity and hence results in faster stabilization of the material.

**Aeration** It is necessary to ensure that oxygen is supplied throughout the mass and aerobic activity is maintained. During the decomposition, the oxygen gets depleted and has to be continuously replenished. This can be achieved either by turning off windows or by supplying compressed air.

During the turning, it is necessary to bring inner mass to the outer surface and to transfer the outer waste to the inner portion.

**Addition of Sewage and Sewage Sludge** The optimum C/N ratio for composting is 25-30. MSW in developed countries has a C/N ratio of nearly 80. To bring it down to the optimum value and to reduce the cost of sewage sludge treatment, it is mixed with sewage sludge (C/N = 5 to 8). MSW in India, on the other hand has an initial C/N ratio of around 30 which does not need blending. If such a mixing is done, C/N value may reduce below 20, when a loss of nitrogen in the form of ammonia occurs.

**Properties of Compost** The compost prepared from MSW should be black brown or at least black in color. It should be crumbly in nature with an earthy odor. The pH should be neutral though slightly acidic or alkaline pH within the range of 6.5 to 7.5 can be tolerated. The compost should neither be completely dry nor it be lumpy and water should not come out of the mass when squeezed.

### **Flowsheet**

In the pre-fermentation type of plant which is preferred, in a majority of Indian urban centers, the incoming trucks can directly discharge their contents in the windrow area.

During composting, the temperature of the mass has to be continuously monitored. This can be done by using probes. The optimum moisture content for composting is between 50-60%, while that in the incoming waste is much lower. The addition of moisture can hence be done through a hose connected to a fire hydrant. During composting, the moisture content tends to reduce and necessary moisture can be similarly added during turning.

After 20 days, the organic matter would be stabilized and the waste can then be taken for further processing.