# On Farm Composting using the VRM Process.

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## Introduction

The purpose of this document is to summarise the composting process developed by Ken Bellamy from Vital Resource Management (VRM). The composting process is currently being used by four NSW councils to transform their residential food and garden waste into a high quality, high nutrient, and biologically active composted product as part of the Groundswell project[1].

The composting process has been designed to meet the following criteria:

- Able to use existing landfill or farm machinery (eg small tractor with blade or front end loader)
- Require minimal new machinery or infrastructure
- Able to operate in exposed sites with no power and minimal water
- Minimal labour and machinery hours
- Simple process that can be managed by existing waste management or farm labour without expert composting knowledge.
- Able to operate consistently with seasonally variable feed stocks.
- Able to effectively manage concerns about putrescibles including odour, vermin and ibis.
- Produce the highest quality biologically active compost from a wide range of difficult or putrescible feedstock and waste products.

## Summary of Composting Process

Feedstocks and waste products containing food, poultry manures or other high nutrient materials create some special opportunities and risks for successful composting. The higher nutrient and moisture levels present in food scraps, meat scraps, poultry and animal manures provides a perfect feedstock to produce a microbe rich, high nutrient product if properly treated. The specifics of the VRM activated composting process (technically more of a fermentative process) are outlined below. In essence, the composting process has been developed for simplicity, cost effectiveness and efficiency while ensuring a premium compost product.

[1] Groundswell is a three year project which is rebuilding the rural-urban relationship by returning organic material from urban communities to farmland. The project is funded by the NSW Environment Trust Urban Sustainability Program.

The composting process is attracting quite a bit of interest due to its low labour, plant and water requirements. The fermentative process reduces the number of turns to just once during the 8-12 week composting process and the pile coverings reduce evaporation and water requirements.

The project is also challenging assumptions that the processing of food, manures and other putrescibles is synonymous with vermin and odour issues and needs to occur indoors or in vessel.

## Feedstock

The composting process outlined in this paper is currently being used to process source separated[2] household kitchen and garden waste. All food scraps including meat, bones and fat are included.

The same process could be used for other feed stocks such as poultry litter, manures, green waste and any other municipal, commercial or agricultural organic materials. Make sure the feedstock you are using or the quantities you are processing comply with the appropriate environment protection legislation.

Within certain limits, the specific balance of carbon to nitrogen in the feedstock is not vital to the composting process because the inoculants contain both carbon fixing and nitrogen fixing bacteria. Best results however, would be achieved where there is nitrogenous material as well as carbon rich materials present.

Common materials such as poultry manure mixed with sawdust, cow manure mixed with sawdust or straw, food scraps mixed with green waste or shredded paper mixed with food scraps should be adequate.

## Stage 1: Picking

Depending on the material being processed, the first task in the composting process is to pick through the feedstock by hand to remove any physical contamination.

[2] Waste that is diverted from the waste stream at it's source – generally at the household level

## Stage 2: Inoculating

Once any physical contamination is removed, the feedstock is sprayed with a two part composting solution produced by Vital Resource Management (VRM) using Effective Micro-organisms (EM®) and an appropriate amount of non or de chlorinated water, piled into windrows and covered with polytarps or black plastic weighed down with tyres.

The composting inoculant is a combination of *VRM Starter Culture*® and *VRM Microbial Seeding Agent*®. The VRM *Starter Culture* and VRM *Microbial Seeding Agent* has been specifically selected to meet the feedstock requirements of a combined food and garden waste collection.

## Dilution Rates

Dilution rates are 1 litre of starter culture and 1 litre of seeding agent in 10 litres of water for every 10 cubic meters of green waste or 2 litres of starter culture and 2 litres of seeding agent in 10 litres of water for every 10 cubic meters for composting with sewage sludge or manures.

**Table 1 Dilution Rates**

| Feedstock | Start Culture | Seeding Agent | Water | Quantity of Feedstock |
|---|---|---|---|---|
| Composting With Green Waste | 1 litre | 1litre | 10 litres | For every 10m³ (cubic meters) |
| Composting with Sewage Sludge | 2 litres | 2 litres | 10 litres | For every 10m³ (cubic meters) |

Both products should be diluted in water at the above rates just prior to application. Ideally the composting solution should be applied under pressure using a full cone spray or atomiser (eg a yellow pressure nozzle) as exposure of the solution to oxygen kick-starts the oxidisation process which kick-starts the biological activity and the fine droplet size maximises surface coverage.

Broadly speaking the inoculants contain combinations of aerobic and anaerobic bacteria, special fungi and yeasts. The composting process is more accurately described as a fermentative process. Specific microbes are included that actively breakdown fats, meats and other difficult products that might challenge a conventional aerobic composting process.

## Moisture Levels

The VRM composting process operates best where the feedstock is quite wet. If the feedstock is dry, it may need to be sprayed with de or non chlorinated water prior to applying the inoculant.

Moisture levels during the fermentation process should fall now lower than 30% with an optimum moisture level of 80% where adequate leachate controls are in place.

## Managing Odour

The inoculants smell like molasses and vaguely like pickles. Depending on the feedstock, odours should be reduced or disappear all together within 24 hours of inoculation. It is a good indication that the fermentation process is working well when there is no noticeable odour coming from the piles. On closer inspection, the piles should smell moist, possibly sweet and vaguely of pickles.

Odour issues are generally caused by the predominance of *sulphur reducing bacteria* which produce hydrogen sulphites. The VRM inoculants include *purple non sulphur bacteria* in the inoculant mix which consume the *sulphur reducing bacteria* and also compete for their food source. The *purple non sulphur bacteria* require anaerobic conditions to flourish and under the right conditions, out-compete the *sulphur reducing bacteria*. Unlike the *sulphur reducing bacteria*, the *purple non sulphur bacteria* are inhibited by sunlight. Covering the piles helps to create the conditions for the *purple non sulphur bacteria* to flourish.

Collectively these composting solutions provide a range of significant advantages.

- Firstly the requirement to turn piles is reduced as the microbial population does not require ventilation.
- Secondly, carbon retention is considerably higher than in regular composting.
- Thirdly, odour is greatly reduced and in most instances eliminated all together.
- Fourthly, the requirement to cover piles with polytarps significantly increases the thermal and moisture efficiency of the piles, reducing both water requirements and runoff.

Additional information on VRM EM® can be found here:
http://www.vrm.com.au/

## Monitoring and Quality Control

The covered piles are left for four to six weeks. During the first day or two the temperature climbs to around 65 - 70 degrees as a flush of aerobic activity takes place. By the end of the first week the temperature stabilises at around 50 – 55 degrees. This early aerobic flush of activity provides the first of two opportunities for pasteurisation. According to the AS 4454 standards, compost must reach and hold a temperature of 55 degrees for three days to achieved pasteurisation requirements. If the

expected temperatures are achieved, the VRM composting process exceeds the pasteurisation requirements outlined in the standard.

In association with the stabilisation of temperature around 55 degrees, the ph level drops to around 3.5 -4.5 as the fermentative bacteria colonise the piles. The piles should remain quite wet, and the colour quickly changes to a uniform black colour. Additionally, *ray* fungi and *actinomyces* quickly start to infiltrate the piles and can be observed as grey filaments or powdery flakes. If these grey powdery flakes and filaments are predominating, it can be an indication that the pile is too dry, so check moisture levels and apply de or non chlorinated water as required.

Depending on the feedstock, evidence of secondary composting processes may be observed on the outer surface of the piles where there is more oxygen and the temperature is cooler through the establishment of slaters, native cockroaches and other larger soil biology. This is good!

Moisture levels during the fermentation process should fall now lower than 30% with an optimum moisture level of 80% where adequate leachate controls are in place.

## Stage 3: Turning and Respraying

After 4 – 6 weeks, the piles are uncovered, spread and re examined to remove any physical contamination that might have been missed at the beginning of the process. By this stage the piles have slumped by about a third. Smaller pieces of contamination become easier to see as the compost has taken on a uniform texture and dark colour.

The compost is then mixed, resprayed, re-piled, recovered and left for another 4 to 6 week period. A similar early spike in temperature (around 65 – 70 degrees) followed by a longer period at around 50- 55 degrees and an associated ph level of 3.5 – 4.5 can be expected during the second fermentation stage. This provides the second opportunity for pasteurisation and ensures material that was previously on the outside of the pile has been reincorporated and processed.

## Stage 4: Curing

After 8 – 12 weeks, the compost is uncovered and exposed to sunlight. If the piles are very high, they can be spread out a little to facilitate the curing process. The compost is ready when the moisture level has dropped to 23%. At this stage, the ph has returned to neutral.

The end product will be predominantly “chocolate brownie” in nature and should smell sweet and earthy. It is usually too fine or soft to put through a shredder or grinder but is suitable for a screening (eg flip screen) process. Larger particles that are screened from the compost can either

be reprocessed into the next compost batch or stockpiled until a shredder or grinder becomes available.

Any last remaining physical contaminants should be removed prior to screening or final processing.

## State 5: Storage

Once the pile has reached a moisture level of 23%, it should be re-piled and covered with tarpaulins again until used. This will maintain the correct moisture level and prevent rain from leaching nutrients from the piles.

## Stage 6: Application

The end product should be screened with the final application method in mind. Depending on what machinery is available, compost could be applied with a manure spreader, super spreader or with a tip truck. The particulate size of the end product will depend to some extent on the nature of the original feedstock.

For large areas another method of application is via spray equipment as a liquid compost tea.

## Adjustments & Trouble Shooting

As mentioned above, within certain parameters the VRM composting process is more forgiving than conventional composting with regards to the carbon / nitrogen balance. It makes sense to source or blend materials that contain both nitrogenous materials (manures, food waste, fresh lawn clippings) and carbon rich materials (straw, sawdust, prunings). If your feedstock is very high in cellulose, try spraying with molasses diluted in water. This will provide a quick carbohydrate source for bacteria which can then kick start the biological process for the breakdown of cellulose materials.

If the pile is very high in carbon (e.g. paper), the pile could be sprayed with liquid nitrogen, urea or some other ready source of nitrogen to kick start the biological process.

If the piles become very wet, liquid may leak out from under the pile. If this liquid is exposed to sunlight, it may begin to smell. This is because the sunlight has killed off the purple non sulphur bacteria which has then allowed the sulphur reducing bacteria to flourish. If the odour is a problem, re-spraying that section and extending the covers over the puddle should fix the odour. Finding a way to direct leachate back into the pile would be an ideal solution.