FEASABILITY STUDY FOR THE IN-HOUSE PROCESSING OF ORGANIC WASTE BY EAST GIPPSLAND SHIRE COUNCIL

Funded by Sustainability Victoria under the Recycling Victoria Councils Fund

Introduction

The East Gippsland Shire Council (EGSC) currently accepts in excess of 15,500T of garden waste at its landfills and transfer stations annually. This waste is periodically mulched to reduce its total volume. Previous years have seen that mulch used in the capping of Landfills however with Lakes Entrance and Cann River Landfills both set to close in 2021 an alternative disposal method will be required going forward. The purpose of this project is to assess the capacity of East Gippsland Shire Council to operate a facility to process Organic waste (including food waste) in to composted soil conditioners.

Background

Garden waste is currently accepted at 9 of the waste facilities (transfer stations and landfills) operated by the East Gippsland Shire Council. The disposal of this waste is currently free of charge (a charge is applied to the disposal of tree stumps). In addition to that dropped to the sites by the public, approximately 20,000 households have a garden waste kerbside collection bin which is collected as part of the kerbside collection contract. This waste is often highly contaminated.

All current legislation is pushing for a reduction of waste to landfill and under the Recycling Victoria Policy all councils are required to remove organic waste from landfill by 2030. The current kerbside collection arrangements in East Gippsland Shire sees food waste disposed of to landfill which will not be an option come 2030. This further drives the need for this project to establish the most effective composting method for East Gippsland Shire Council.

The construction and operation of an organic waste composting facility is one possible solution which East Gippsland Shire Council could utilise is processing organic waste moving forward. A composting trial was carried out adjacent to the Bairnsdale landfill thanks to funding from Sustainability Victoria under the Recycling Victoria Councils fund. This document presents the results of this trial and discussed the potential for East Gippsland Shire Council to operate a facility based on the trials outcome.

Composting Trial

Trial Summary

There are a wide range of processes which can be used for the composting of organic waste and each have their advantages and disadvantages. Four composting methods were selected for this trial consisting of two aerobic and two anaerobic. Of the four methods which were selected for this project two (1 & 2) were chosen based on their proven track records in other Australian Composting facilities, and two (3 & 4) are hybridised versions of proven methods.

Method 1- Turned Open Windrow

Open windrow composting is the most common method used in commercial composting. This method requires organic waste to be mulched prior to being arranged in windrows for open composting. This method requires the frequent turning of windrows to ensure even pasteurisation and breakdown of feedstock. This method requires around 1 Megalitre of water per 1000 tonne of feedstock to maintain optimum moisture levels. This method requires uncontaminated feedstock to ensure a high-quality product. The final product is passed through graded screens to ensure over-sized material is removed.

Method 2- SPICE

Static Pile Inoculated Compost Extension (SPICE) is a method of composting whereby a biological inoculant (see appendix 2) is added to organic waste prior to composting in a covered environment. The biological inoculant which comprises largely of Lactobacillus enables a process of anaerobic digestion. The biologic process active in this method reduces odour, removes the need to mulch the feedstock and requires very little water during the process. Unfortunately, this method generates higher levels of Methane due to the anaerobic nature of the process.

This process does not require turning during the composting process however best practice suggests turning after six weeks to ensure complete pasteurisation.

Method 3- Un-shredded Spice

This Hybrid Method will see the shredding of feedstock prior to inoculation. Following inoculation, the regular SPICE process will be followed. This process is capable of processing contaminated feedstock as the contaminants remain whole and can be removed at the end of the process through a simple screening process. This Process is currently utilised by the Mallacoota Kitchen to Compost facility as well as a site in Begs, NSW. Armidale Council in NSW also uses this method to process 50,000 Tonnes per year.

Method 4- Static Open Windrow

This Hybrid Method will see the open windrow methodology followed however the windrows will not be turned.

Figure 1 below demonstrates the configuration of trial rows on the trial hardstand.

Figure 1: Configuration of trial methods on hardstand area

Trial Methodology

The feedstock used for this composting trial consisted of garden waste deposited at the Bairnsdale Regional landfill both through kerbside collections and public drop off. The shredding of garden waste began on 25 October 2021 and finished on 29 October 2021. 30m^3 of this shredded feedstock (un-shredded for windrow 3) was used for each windrow. An average bulk density for the shredded feedstock (Windrows 1,2 & 4) was calculated at 500kg/m^3 and 326kg/m^3 for the un-shredded feedstock (Windrow 3).

The windrows were formed on 2nd November 2021, between 4-8 days after shredding. The formation of windrows was carried out using a 10m^3 capacity dump truck and a JCB Telehandler with bucket attachment. At this time, 1000L of water was added to each windrow. Windrows 2 and 3 also had the liquid inoculant added with the water at a dilution rate of 8:1 (water: inoculant). See appendix 1 for inoculant preparation. Windrows 2 and 3 were covered with tarps and weighed down with tyres.

Temperature checks were taken daily. Internal temperatures were taken with a 1m probe at three points in each windrow. The 1m probe was replaced by a 40cm probe on 06/12/2021 which resulted in internal temperatures being taken closer to the surface of the windrow. External temperatures were taken at three points on each row with a digital laser thermometer. 10 non-consecutive days of temperature checks were missed during the composting process due to covid related staff shortages.

Samples were taken periodically from windrow 1 for moisture content by weight testing by Terra Firma Labs using a material dehydration process. As there was no intention to add water to windrows 2,3 and 4 their moisture content was tested less regularly. On each occasion a sample of organic material was taken to a depth of 50cm. The sample material was mixed to ensure a representative sample.

Windrow 1 was turned 6 times during the composting process to ensure sufficient aeration was maintained. The telehandler with bucket attachment was used to turn the windrow by spreading the material out over the hardstand before reforming the windrow. The turning occurred on 10/11/21, 23/11/21, 13/12/21, 20/12/21, 11/01/22, 23/01/2022. An additional 700L of water was added to the windrow while being turned on 23/01/22.
Windrow 2 was turned once during the composting process on 23/01/22 and re-covered.

A sample was taken from windrows 1,2 and 4 on the 22/01/2022. These samples were taken by removing 1m^3 of material from the end of the windrow with the bucket of the telehandler. The material was then mixed to ensure a representative sample. 20L of the material was placed in a clean bucket and sealed. The telehandler bucket was then washed before repeating the process on windows 2 and 4. Windrow 3 was excluded from this process as the material remained largely intact. These samples were sent to Environmental Analysis Laboratories (EAL) at Southern Cross University for testing in line with 'AS:4454 Composts, Mulches and Soil Conditioners'.

The trial concluded on 01/03/2022 after 120 days of processing. The above sampling process was repeated for windows 1,2 and 4 and samples sent to EAL for testing in line with AS:4454 and Microbiology analysis.

Trial Results

Windrow Moisture was tracked throughout the composting process. Windrow 1 was consistently tested while windrows 2, 3 and 4 were tested less regularly. The windrow moisture content at each test point can be found in table 1 below.

Sample Date	Row 1	Row 2	Row 3	Row 4	Source
27/10/2021	56.0%	56.0%	56.0%	56.0%	Terra Firma
3/11/2021	62.1%	67.8%	152.9%	76.4%	Terra Firma
22/11/2021	92.9%			88.5%	Terra Firma
8/11/2021	59.6%			63.1%	Terra Firma
13/12/2021	59.1%	76.9%		60.2%	Terra Firma
9/02/2021	59.0%	36.8%		81.7%	Terra Firma
3/12/2021	60.0%			72.8%	Terra Firma
12/01/2021	70.0%				Terra Firma
22/01/2021	32.0%	41.0%		34.0%	Southern Cross University
2/03/2021	31.0%	43.0%		39.0%	Southern Cross University

Table 1: Windrow moisture content

Table 2 below presents the weekly average internal windrow temperature for each windrow.

Week	Row 1	Row 2	Row 3	Row 4
1	50.10	50.73	34.44	50.94
2	44.69	43.10	28.33	46.84
3	53.61	53.40	44.45	56.69
4	57.27	48.23	39.74	50.47
5	60.10	59.89	51.13	58.89
6	35.14	29.00	28.62	31.95
7	57.09	40.86	38.60	52.94
8	54.71	38.04	31.72	52.10
9	55.10	37.97	30.03	53.86
10	55.13	37.72	33.43	52.94
11	54.00	36.11	32.55	47.67
12	53.10	33.39	32.51	44.29
13	59.12	34.72	34.35	57.40
14	54.71	33.18	33.54	46.56
15	53.07	33.77	34.24	44.28
16	51.28	34.82	33.89	44.90
17	51.08	35.82	33.54	43.34
18	14.43	10.29	8.64	10.20

Table 2: Weekly average windrow internal temperature

Table 3 below presents summarised results of compost analysis in line with AS4454 which was conducted by EAL. Full test results can be found in Appendix 2.

	Sample 1	Sample 2	Sample 3	
Product Name:	WR 1	WR 2	WR 4	***Guideline***
Product Type:	Compost	Compost	Compost	*AS4454:2012 Composted Product*
Sample Collection Date:	2/03/2018	2/03/2018	2/03/2018	
Standard Applicable:	AS4454:2012	AS4454:2012	AS4454:2012	
Parameter	**M6950/1**	**M6950/2**	**M6950/3**	
Wet Bulk Density (kg/L)	0.78	0.78	0.75	*..*
Dry Bulk Density (kg/L)	0.54	0.45	0.45	*..*
Moisture Content (%)	31	43	39	*> 25*
pH	7.74	7.87	7.90	*> 5*
Electrical Conductivity (dS/m)	2.53	2.36	1.53	*< 10*
Total Organic Carbon (%)	14.6	22.5	17.9	*≥ 20*
Total Carbon (%)	15.2	22.5	18.1	*..*
Total Nitrogen (%)	1.15	1.19	1.07	*≥ 0.8*
Carbon/Nitrogen Ratio	12.7	18.9	16.6	*..*
Estimated Organic Matter (% OM)	24.8	38.3	30.4	*..*
Ammonium Nitrogen (mg/L N)	3.6	2.7	2.5	*< 200*
Nitrate Nitrogen (mg/kg N)	69.5	69.0	84.5	*≥ 10*
Phosphate Phosphorus (mg/L P)	10.5	14.8	16.7	*≤ 5*
Ammonium/Nitrate Ratio	0.3	0.2	0.1	*< 3.0*
Nitrogen Drawdown Index (NDI_{150})	0.7	0.7	1.0	*> 0.2*
Particle Size Grading > 16 mm Sieve (%)	3.4	4.2	9.5	
Particle Size Grading 5–16 mm Sieve (%)	15.2	15.1	15.5	
Particle Size Grading < 5 mm Sieve (%)	81.4	80.7	75.0	
Plastics Light Flexible or film > 5 mm (%)	<0.01	<0.01	0.10	*≤ 0.05*
Stones and Lumps of Clay > 5 mm (%)	7.36	8.68	11.62	*≤ 5*
Glass, metal and rigid plastics > 2 mm (%)	<0.01	<0.01	<0.01	*≤ 0.5*

Table 3: Summarised AS4454 test results

Trial Discussion

Process

The composting processes trailed were selected based on their proven track records and recommendations of industry professionals. It became evident early in the trial process that windrow 3 (un-shredded SPICE) would not be a viable method to use in the timeframe available. As such it was decided in early December to ‘abandon’ windrow 3 to ensure resources weren’t wasted on its testing. The only test carried out on windrow 3 past this point was the daily temperature check. As such, windrow 3 will not be further discussed.

Moisture

The moisture content testing performed on 27/10/2021 consisted of a sample of the raw feedstock used for this trial and was intended to provide a baseline moisture content prior to any treatments being applied.

As detailed in table 1, windrow 2 was tested for moisture content only 6 times throughout the process while windrow 4 was tested 9 times and windrow 1 10 times. The variation in frequency of moisture sampling was due to the varied requirements and properties of each trial method. Moisture testing which was carried out was targeted primarily at windrow 1 as it was the most likely to lose significant volumes of moisture due to evaporation while turning. Windrow 2 was covered as to retain moisture, and as such was tested less frequently for moisture content. Windrow 3 was a static row meaning additional moisture could not be effectively added even if required.

Above average rainfall was experienced during the trial period which resulted in the outsides of windrows 1 & 4 and the base of windrow 3 becoming saturated while the interior of the rows remained comparatively dry. It is possible that this high rainfall created an oxygen starved environment within the saturated layers.

The use of the telehandler for turning windrows visibly resulted in an inconsistent distribution of moisture through the window. As such, the establishment of a full-scale composting facility would require a windrow turner of appropriate size to process the annual volume of organic waste.

Temperature

During the trial period, temperature checks were planned daily. Unfortunately, several days were missed though the trial period due to Covid-19 related staff shortages. Issues were also experienced with the thermometers used for testing internal temperature. The 1m compost thermometer which was used for the first week of the trial developed a fault in the screen rendering it un-usable. A replacement 1.5m probe was ordered with a Jumbuck digital meat thermometer being used for 11 days until the replacement arrived. The Jumbuck thermometer allowed for temperature checks to be taken at a depth of approximately 30cm which is not representative of the windrows core temperature. The 1.5m probe was used until 06/12/2022 when it was also stopped working due to a fault. A 40cm analogue temperature probe was then used for the remainder of the trial. The 40cm probe did not provide accurate temperature records of the windrows core due to the shallow measurement depth.

In line with EPA publication 1588.1 ‘Designing, constructing and operating composting facilities’ (the guideline) the optimum windrow temperature range to achieve pasteurisation is between 55^{o}C and 75^{o}C. Based on the guideline the low-risk wastes composted during this trial need to be turned a minimum of 3 times during the composting process having held an internal temperature of 55ºC or higher for a minimum of 3 days prior. Windrow 1 achieved this benchmark for pasteurisation based on the daily temperature records and frequency of turning. This is confirmed by the results of AS4454 testing which confirmed pasteurisation.

Figure 2: Vegetative Growth in windrow 4

As windrow 4 was not turned during the composting process it did not achieve even pasteurisation. The temperature checks indicate the achievement of temperatures over 55ºC for an extended period in the rows core, however, this did not eradicate viable plant propagules or seeds as was evidenced by plant growth on the outside of the windrow (Figure 2).

Windrow 2, while achieving pasteurisation temperatures was only turned once during the process and as such may not have achieved even pasteurisation. AS4454 tests results did however indicate that there were no viable propagules or pathogens present in the sample. It is also prudent to note that this method is largely anaerobic whereas the guideline refers specifically to aerobic composting processes.

AS4454 Compliance and compost quality

As summarised in Table 3 and detailed n Appendix 1, the compost produced largely achieved the requirements of AS4454. All 3 windrows exceeded the threshold for both phosphate phosphorous and total phosphorus; however, this is only relevant where a product claims to be for phosphorous sensitive plants.

Windrows 1 and 3 were low in organic carbon. A possible explanation for this is feedstock low in organic carbon, however, this is unlikely as the same feedstock was used for all windrows. Another explanation may be sand having been mixed into the windrow while turning which will reduce the overall carbon content of the windrows. While this may explain the low organic carbon content in windrow 1 it does not explain windrow 4 due to the row not being turned.

Each of the 3 windrows exceeded the 5% AS4454 limit for stones and lumps of clay >5mm. This exceedance is easily explained by the use of the telehandler bucket to form and turn windrows. The bucket visibly collected sand and stones from the gravel hardstand when moving material and it is these stones which remained in the final product.

The spreading of weeds and pathogens through composted organics is the highest risk East Gippsland Shire Council has identified in producing and distributing a composted soil conditioner. The AS4454 test results indicate that the compost product produced by all 3 methods was free from (or well within allowable limits) viable plant propagules and all pathogens tested (salmonella, E.coli and Faecal Coliforms). Similarly, all heavy metals tested for under AS4454 were well within allowable limits for the 3 methods trialled.

Process Labour Requirements

The labour requirement for the composting trial is likely an inaccurate guide for the requirements of a full-scale composting facility. The trial was conducted using plant and equipment which was not always fit for task such as the telehandler. Each time windrow 1 was turned it took approximately 30 minutes to ensure as even mixing as possible whereas a specialised windrow turner would handle the same volume of material in under 2 minutes. Similarly adding moisture to the windrows took 2 staff 6 hours to add the required volume and evenly mix the material whereas a windrow turner would add moisture while turning. Temperature checks took 1 staff member 1 hour per day but would likely be automated in a full-scale composting facility. A full-scale composting facility would require an onsite grinder for daily use whereas a contractor was engaged to grind waste for this trial.

Garden Waste Sorting Trial

Trial Summary

Garden waste collected through kerbside services is often highly contaminated with inorganic waste material. A 2021 audit of East Gippsland kerbside bins by A.Prince consulting found that on average, 2.6% of material in garden waste bins was contamination. Prior to feeding a composting process this material would require decontamination. As such an organic waste decontamination trial was conducted at the Bairnsdale landfill to determine the resourcing required to effectively decontaminate organic waste prior to feeding a composting process.

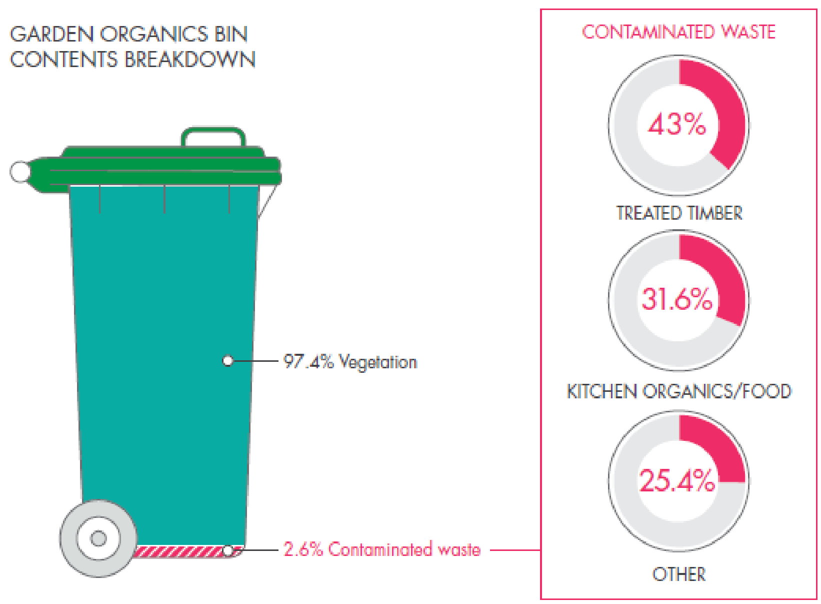

Figure 3: Breakdown of contamination in garden organics bin

Trial Methodology

Three loads of organic waste collected through council's kerbside collection service were randomly selected and dumped in piles separate from other organic waste. Each load was then spread with a telehandler bucket and 2 site staff (telehandler operator plus one) manually

picked contaminants from the organic waste. Following removal of contaminants, the material was added to the main stockpile of organic waste.

The contaminants were bagged and weighed on a hanging scale to determine the weight of contaminants in each load. These weights were then compared against the total load weight to determine contamination percentage.

Trial Results

This decontamination process took 25 minutes per load on average. Of this time the telehandler was running for 15 minutes.

The contamination of each load varied significantly; the volumes of contaminants are displayed in Table 1 below.

Load	**Load Weight**	**Weight of contaminants**
1	7.4t	10.5kg
2	6.32t	20.9kg
3	2.82t	<1kg

Table 1: Rates of contamination in Organic Waste

Based on the results of this decontamination trial it can be expected that the decontamination of 1 ton of organic waste requires 9 minutes of labour (4.5 minutes per person) and 54 seconds of plant operation. Realistically, organic waste would be left to form a stockpile before decontaminating rather than processing one load at a time. As such, more realistic labour requirements should be calculated per 100t of material. Processing 100t would require 7.5hrs of labour and 1.5hrs of plant operation.

Assessment of in-house composting

Overview

Based on the trials conducted at the Bairnsdale landfill, Council officers are confident in their ability to establish and operate a commercial composting facility for the processing of municipal organic waste. The open windrow composting process trialled, produced a high-quality compost product which officers expect to hold significant value as a soil amendment for agricultural properties in East Gippsland. As such, the resultant product will likely provide council with an income stream to offset processing costs.

Council plans to introduce a Food Organics and Garden Organics (FOGO) collection service in 2025 and as such any composting facility constructed would have to be suitable for FOGO processing. According to the guideline FOGO places organic feedstock in a higher risk category than GO only. Officers have investigated 'bunker' style forced air floor composting systems which are currently in use around Australia including City of Wangaratta which was visited during this trial and have determined that style of system as the best suited to councils needs in composting FOGO. This type of system ensures efficient pasteurisation by forcing air through the organic material to ensure even aeration.

Process investigations through a visit to the City of Wangaratta composting facility, Australian Organics Recycling Association conference, City of Geelong composting facility and Gippsland Regional Organics have provided valuable insights into the process, plant and equipment which will be required for council to effectively process organic waste through an in-house facility.

Costs

Estimated costs for the construction and operation of a composting facility at the Bairnsdale Regional Landfill are summarised below. A comprehensive breakdown and assessment of costs can be found in the project plan.

Item	Annual Cost Low	Annual Cost High
Staff Costs @ 2.5fte	$ 176,649.00	$ 189,090.00
Plant Operating Costs (Fuel, servicing etc.)	$ 144,500.00	$ 180,625.00
Utilities	$ 30,000.00	$ 60,000.00
Site Maintenance	$ 20,000.00	$ 50,000.00
Capital cost amortised over 10 years	$ 425,905.00	$ 553,676.50
Total Annual Cost	$ 797,054.00	$ 1,033,391.50
Total Cost per Tonne (25,000t)	$ 31.88	$ 41.34

Appendix 1.

SPIC Compost Inoculant

For use in the Static Pile Inoculated Covered Compost process

This Factsheet provides a simple recipe for making an inoculant for use in no-turn, covered composting systems. This inoculant can also be used as a conditioner for soils and for odour control in manures, compost sites and intensive animal operations.

What are Inoculants?

Inoculants are products that contain living micro-organisms such as bacteria, yeasts and fungi. Micro-organisms play important roles in the environment including helping to decompose organic matter, cycle nutrients and in plant health. Inoculants can be used to add beneficial micro-organisms to a situation to get a specific biological process. For example a well known inoculant product in agriculture is a bacteria called *Rhizobia*. This product is added to legume seeds to help fix nitrogen into agricultural soils from the air as a legume crop grows.

Finished SPIC Compost: Far North Queensland

SPIC Compost Inoculant

The SPIC Compost Inoculant is a biological product that contains micro-organisms that help to decompose and compost organic materials. It can be made and stored easily on the farm. The inoculant is applied to the materials that are to be composted as you are setting up a no-turn compost pile.

The compost inoculant is a fermentation based product. This means the micro-organisms in them can live in low levels of oxygen. These are the conditions that exist in the SPIC Compost system where a cover is used to control the level of air and the pile is not turned. The aim of using the inoculant is to help control the process of composting in the pile and ensure that the right community of micro-organisms are doing the composting process. This results in a quality compost product.

Adding inoculant to compost feedstock: Armidale Regional Council

The Recipe has 2 parts

Mixture 1 – Lab Serum - Also known as EM, this is a base mixture which contains a concentration of microbes. <u>You need to make this first.</u>

Mixture 2 – Compost Inoculant - This mixture is made from Mixture 1 mixed with a range of other ingredients to broaden its effectiveness. <u>Mixture 2 is what you apply to compost.</u>

SPIC Compost Inoculant

For use in the Static Pile Inoculated Covered Compost process

Mixture 1 – Lab Serum

Also known as *EM*, this is a basic inoculant that is consists mainly of a well known group of fermenting bacteria called *Lactobacillus*. It is used as a base for Mixture 2. It makes a product which is very similar to Effective Mircoorganisms (EM). It can also be used directly on soils and plants or further fermented with other ingredients to make a wide range of agricultural inoculants and biostimulant products.

Ingredients & Equipment

Clean water (non-chlorinated)	**Milk** (fresh, UHT or powdered)
Rice (brown or white)	**Large jar** (plastic or glass 1 litre)
Molasses	**Plastic barrel** (15 to 20 litres with wide lid)

Preparation

This makes about 6 litres. You can scale this recipe up as needed. Make more than you need as it stores well. Always use clean, non- chlorinated water and clean containers...

Step 1: Capture inoculant by putting 1 cup of rice into a large open mouthed container with 1 litre of clean water. Leave for 3-5 days in dark place with a loose fitting lid. The temperature is best over about 20C. The liquid should change and after this time it should smell slightly sour and may have a slightly milky colour in it. Decant the water off and keep it. Throw away the rice. This liquid is a culture mainly of *Lacto-bacillus* species.

Step 2: **Feed inoculant** by adding the 1 litre of liquid Lacto-bacillus culture to 2 litres of milk in a large container with a wide mouth. The milk must contain lactose. Lactose free milk should not be used. Cover with loose fitting lid and store for a few days until it curdles and milk solids separate. Remove the solids. Keep the creamy- yellow whey. This is known as the *Base Serum.*

Step 3: Stabilise the product by adding equal parts water to the *Base Serum* (you should need about 3 litres of water as you should have about 3 litres of Base Serum). Add about 250ml of molasses per 3 litres of water. This is your stable *Mixture 1* product (also called *LAB Serum).*

Step 4: Store the product in a cool place with the lid tightly on. It can remain stable for a number of years. It should be a light to mid-brown colour with a slightly sweet-sour smell. Some light to brown yeasts may colonise the surface. This is OK. The pH should about 4.

SPIC Compost Inoculant

For use in the Static Pile Inoculated Covered Compost process

Mixture 2 – Compost Inoculant

This is a more complex inoculant that is consists Mixture 1 combined with a range of other ingredients. It is used to inoculate no-turned compost. This Mixture is made in a large container so a 200 litre barrel, 1000 litre shuttle (IBC) or a wheelie bin are ideal to make it in.

Ingredients & Equipment

Clean water (non-chlorinated)	**Fresh leafy green plant material**
Mixture 1	**Clean 200 litre barrel** (wheelie bin or shuttle)
Molasses	**Hessian sack** (potato or coffee sack)
Bone meal (or meat meal)	**Sea water** (or sea salt)
Rice Bran	**String to secure sack**
Measuring jug (1 litre)	**10 Litre bucket**

Preparation

This makes about 200 litres. You can scale this recipe up as needed. This does not have a shelf life longer than around a few months so is best used soon after manufacturing. Always use clean, non- chlorinated water and clean containers…

Step 1: Fill barrel with around 100 litres of water

Step 2: **Prepare hessian 'tea bag' sack** by placing 15 – 20 litres of fresh green leafy plant material (grass, weeds, herbs, fresh seaweed etc.), 3 litres of bone meal, 3 litres of rice bran into the sack and closing it with string. You can add a handful of basalt rock dust if available. Place the 'teabag' like sack into the barrel and secure to the side of barrel so you can readily access it.

Step 3: Add nutrients to water by mixing 3 litres of molasses, 5-7 litres of seawater and 6-10 litres of Mixture 1 (Lab Serum) to the barrel. Then fill the remainder of the barrel to the top with clean water. If you do not have access to seawater then make it by adding 1 cup of sea salt to 7 litres of clean water. Now add the balance of water to the barrel (around 50 litres).

Step 4: Activate the mixture. Close lid on barrel and leave the mixture to activate for 5 days. Every day open the lid to check on the mixture and jiggle the 'teabag' sack at least once a day every day for the 5 days. After 5 days remove hessian tea bag and discard the contents of the tea bag into your compost. Keep the liquid in the barrel. This is Mixture 2 (also called *Compost Inoculant*) and is now ready for use.

Step 5: Use the inoculant . Apply the compost inoculant as a foliar or soil stimulant dilute 1 litre with 10 litres of clean water. When applying as a compost inoculant apply at 1 litre per 10 cubic meters. Do not be concerned if a grey mix forms on top of the mixture after a few weeks. The product should be used within 3 – 4 months.

Appendix 2.

		Sample 1	Sample 2	Sample 3	Guideline
	Product Name:	WR 1	WR 2	WR 4	***Guideline***
	Product Type:	Compost	Compost	Compost	
	Manufacturing Site:	East Gippsland Shire	East Gippsland Shire	East Gippsland Shire	*AS4454:2012 Composted Product*
	Manufactured Date:	3/03/2022	3/03/2022	3/03/2022	
	Test Code:	CA-PACK-003	CA-PACK-003	CA-PACK-003	
	Standard Applicable:	AS4454:2012	AS4454:2012	AS4454:2012	
Parameter	**Method Reference**	**M6950/1**	**M6950/2**	**M6950/3**	
Wet Bulk Density (kg/L)	AS4454:2012 Appendix J	0.78	0.78	0.75	..
Dry Bulk Density (kg/L)	AS4454:2012 Appendix J	0.54	0.45	0.45	..
Moisture Content (%)	AS4454:2012 Appendix I	31	43	39	*> 25*
pH	AS4454:2012 Appendix B	7.74	7.87	7.90	*> 5*
Electrical Conductivity (dS/m)		2.53	2.36	1.53	*< 10*
Total Organic Carbon (%)	AS4454:2012 Appendix C	14.6	22.5	17.9	*≥ 20*
Total Carbon (%)		15.2	22.5	18.1	..
Total Nitrogen (%)		1.15	1.19	1.07	*≥ 0.8 see note 7*
Carbon/Nitrogen Ratio	Calculation - Total Organic Carbon/Total Nitrogen	12.7	18.9	16.6	..
Estimated Organic Matter (% OM)	Calculation - Total Organic Carbon x 1.7	24.8	38.3	30.4	..
Ammonium Nitrogen (mg/L N)	AS4454:2012 Appendix B Dissolved Nutrients	3.6	2.7	2.5	*< 200*
Ammonium Nitrogen (mg/kg N)		18.0	13.3	12.5	..
Nitrate Nitrogen (mg/L N)		13.9	13.8	16.9	..
Nitrate Nitrogen (mg/kg N)		69.5	69.0	84.5	*≥ 10 see note 7*
Phosphate Phosphorus (mg/L P)		10.5	14.8	16.7	*≤ 5 see note 7*
Phosphate Phosphorus (mg/kg P)		52.6	73.9	83.4	..
Ammonium/Nitrate Ratio	Calculation - Ammonium/Nitrate	0.3	0.2	0.1	*< 3.0*
Nitrogen Drawdown Index (NDI_{150})	AS4454:2012 Appendix O	0.7	0.7	1.0	*> 0.2*
Total Calcium (%)		1.11	1.11	1.03	..
Total Magnesium (%)		0.27	0.25	0.23	..

Total Potassium (%)	AS4454:2012 Appendix D Total Salts	0.73	0.80	0.64	..
Total Sodium (%)		0.12	0.11	0.09	*<1 Na*
Total Sulphur (%)		0.13	0.14	0.13	..
Total Phosphorus (%)	AS4454:2012 Appendix D	0.20	0.19	0.20	*≤ 0.1 P* see note 10
Total Zinc (mg/kg)	AS4454:2012 Appendix D Total Metals	142	130	908	*< 300 Zn*
Total Manganese (mg/kg)		308	246	264	..
Total Iron (mg/kg)		10,260	7,500	7,616	..
Total Copper (mg/kg)		29.2	23.8	21.3	*< 150 Cu*
Total Boron (mg/kg)		19.8	21.1	18.8	*< 100 B*
Total Silicon (mg/kg)		1,353	1,573	1,517	..
Total Aluminium (mg/kg)		4,410	3,793	3,636	..
Total Molybdenum (mg/kg)	AS4454:2012 Appendix D Total Metals	1.09	1.05	<1	..
Total Cobalt (mg/kg)		3.54	2.84	3.32	..
Total Selenium (mg/kg)		<1	<1	1.25	*< 5 Se*
Total Cadmium (mg/kg)	AS4454:2012 Appendix D Total Heavy Metals	<0.5	<0.5	<0.5	*< 1 Cd*
Total Lead (mg/kg)		45.1	46.3	29.4	*< 150 Pb*
Total Arsenic (mg/kg)		12.1	8.02	9.82	*< 20 As*
Total Chromium (mg/kg)		24.4	21.6	27.5	*< 100 Cr*
Total Nickel (mg/kg)		6.74	5.04	5.65	*< 60 Ni*
Total Mercury (mg/kg)		<0.1	<0.1	<0.1	*< 1 Hg*
Total Silver (mg/kg)		<1	<1	<1	..
Polychlorinated Biphenyls (mg/kg)	Sub** - SGS Laboratories SE230425 Pesticides and PCBs	<LOR	<LOR	<LOR	*< 0.2*
Organochlorine Pesticides - DDT, DDD, DDE (mg/kg)		<LOR	<LOR	<LOR	*< 0.5*
Organochlorine Pesticides - Other (mg/kg) see note 9		<LOR	<LOR	<LOR	*< 0.02*
Salmonella spp (Absent in 25 g)	Sub** - Symbio Laboratories B Indicator Pathogens	ND	ND	ND	*Absent in 25 g*
E. coli (MPN/g DW)		ND	3.6	ND	*< 100 MPN/g*
Faecal Coliforms (MPN/g DW)		ND	3.6	ND	*< 1000 MPN/g*
Particle Size Grading > 16 mm Sieve (%)	AS4454:2012 Appendix G Particle Size Grading	3.4	4.2	9.5	.. see note 5
Particle Size Grading 5–16 mm Sieve (%)		15.2	15.1	15.5	.. see note 5
Particle Size Grading < 5 mm Sieve (%)		81.4	80.7	75.0	.. see note 5
Plastics Light Flexible or film > 5 mm (%)		<0.01	<0.01	0.10	*≤ 0.05*

Stones and Lumps of Clay > 5 mm (%)	AS4454:2012 Appendix I Visible Contaminants	7.36	8.68	11.62	*≤ 5*
Glass, metal and rigid plastics > 2 mm (%)		<0.01	<0.01	<0.01	*≤ 0.5*
Wettability (min)	AS4454:2012 Appendix E	>5min	>5min	4m 48s	*< 5*
Plant Growth Test - Root Elongation (mm)	AS4454:2012 Appendix F	61	72	91	*> 60*
Viable Plant Propagules (7 days)	AS4454:2012 Appendix M	Nil	Nil	Nil	*..*
Viable Plant Propagules (21 days)	AS4454:2012 Appendix M	NR	NR	NR	*Nil after 21 days*

* < LOR Less than limit of reporting. *ND* Not detected. *NA* Not applicable. *NR* Not required.

Notes:

1. Methods from AS4454:2012 *Composts, soil conditioners and mulches*.
2. Indicative guidelines are based on those in AS4454:2012 for raw mulches, pasteurized product, composted product, mature composts.
3. Total Acid Extractable Nutrients indicate a store of nutrients.
4. Conversions for 1 mg/kg = 1 ppm; 1 % = 10,000 ppm; kg/ha = mg/kg x 2.24.
5. Coarse Mulch > 70% >16mm, Fine Mulch <20% >16mm and <20% <5mm, Soil Conditioner <20% >16mm.
6. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate.
7. Guide only to be used if a product claims to contribute to plant nutrition.
8. The full test observes the potential growth of viable plant propagules in a 21 day test period. In order to pass there should be Nil after 21 days
9. Other Organochlorines include: Aldrin, Dieldrin, Chlordane, Heptachlor, HCB, Lindane, BHC Other Organophosphorus include: Guthion, Bromophos-ethyl, Chlorpyriphos, Chlorpyriphos-methy, Diazinon, Dichlorvos, Dimethoate, Ethion, Fenitrothion, Malathion, Parathion, Ronnel.
10. Guide only to be used if a product claims to be used for phosphorus sensitive plants.