COMPOSTING BIOSOLIDS

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ABSTRACT

This paper is an overview of the biosolids composting process being developed at the Resource Recovery Facility (RRF), Dutson Downs which is owned and operated by Gippsland Water. This process is being developed to reduce risk and improve environmental outcomes relative to direct land application of biosolids.

The paper will discuss the process that was developed and some of the things that were learnt along the way including:

- The establishment of a composting area
- The composting process and methodology
- Validation testing of the final product
- What we have learned
- Where to next
- Conclusions

1.0 INTRODUCTION

Biosolids are a by product of wastewater treatment. Traditionally biosolids are dewatered and stockpiled for a minimum of two years prior to direct land application. They are difficult to handle, slump and require a relatively large area for storage, tend to develop unpleasant odours and are very difficult to apply to land using conventional agricultural equipment.

Composting is one way to convert this relatively undesirable product to a friable, pleasant smelling earthy product that is easy to handle for both domestic and agricultural applications over an 8 to 12 week period.

Gippsland Water operates five activated sludge Sewage Treatment Plants (STP). At the Warragul STP, waste activated sludge is thickened and dewatered using a conventional belt press. A cationic polymer is mixed with the Waste Activated Sludge and then passes through a drum thickener and on to a belt press. The resultant product is around 16% to 18% solids. Approximately 35m3 of product is produced each week. This product has been transported approximately 130km to an agricultural site and stockpiled for a period prior to application to the land. The application to the land has always been a relatively smelly and sticky job.

With the changing emphasis on reuse of biosolids, a decision was taken to further process the biosolids to produce a more acceptable product for reuse. The decision was taken to use composting.

2.0 ESTABLISHMENT OF A COMPOSTING PAD

A thick gravel pad consisting of a compacted road base material, approximately 30m by 120m was established for the composting operations. This pad was constructed so any leachate would be collected in an adjacent drain and disposed of to a nearby wastewater pond.

After the first composting trials, the pad area was found to be too small to be able to compost all of the biosolids being produced. The pad was therefore extended by a further 120m by 45m.

A water supply main was installed around the pad with multiple outlets to allow easy application of water to the windrows when necessary and a small transportable building established for testing and monitoring.

3.0 COMPOSTING

The starting point for the composting was a basic mix of 2 parts of shredded green waste to 1 part biosolids (2:1 v/v). This gave a carbon: nitrogen ratio of about 17:1. Our target ratio was 20:1. The basic mix was therefore changed to 2.5:1 to achieve more preferable carbon to nitrogen ratio.

Shredded green waste has been obtained from a number of local suppliers. One of our main problems has been with the level of contamination, (plastic, metal, concrete, dolls heads, tennis balls, cans, shade cloth and other general garbage and litter). There have also been issues associated with oversize wood chips, large branches and lumps of wood within the green waste. Contaminants and oversize materials have damaged the windrow turner on a regular basis.

The windrows were constructed by firstly laying out a long bed of green waste that was wide enough for a truck to drive along. Biosolids were then deposited directly from the trucks along the green waste bed (Figure 1). The sides of the bed were then folded over, any extra green waste added to make up the correct ratios, and then formed into a windrow small enough for the windrow turner to fit over.

Figure 1: ***Biosolids being deposited upon a bed of green waste.***

When doing the initial trials, the windrow turner was passed through the piles numerous times. It was found that excessive mixing with the turner caused the biosolids and green waste to mash together in big clumps which were hard to break up and didn't allow air flow meaning these clumps became anaerobic and odorous. As a result it was found that a maximum of three passes was necessary to ensure that clumping did not occur.

When the pile was mixed initially with three passes of the turner, then left to dry for a few days, then mixed again, a well homogenised mixture was achieved which was still fairly porous, allowing better air flow through the pile. The mixture became easier to mix as the materials began to compost. For this reason our procedure has now been standardised for 3 passes with the windrow turner (figure 2).

Figure 2: ***Compost turner in action***

3.1 Monitoring

The composting process, while simple, needs to be monitored carefully. The piles are monitored for temperature, moisture level and initially, oxygen. Because of the tackiness of the biosolids, oxygen sampling probes continually became blocked and so were found to be impractical for this application. Enough data was collected though, to indicate that, as the oxygen level in the pile depleted, the microbial activity slowed and the temperature began to fall. This meant that the piles could be managed and turned based on temperature. The aim is to keep the temperature between 55°C to 65°C.

Moisture tests are also periodically done (usually about once per week depending on weather conditions) on the compost and, if needed, water added to try and maintain optimum moisture levels in the piles. The target is to keep the pile between 50% to 60% moisture. Moisture levels are determined by weighing out a sample then putting it in a microwave oven, weighing it every minute or so until there is no weight change. The difference in weight can be used to determine the moisture as a percentage. This information can then be applied to the volume of the windrow to calculate how much water needs to be added.

Open windrow composting requires the compost to be turned 5 times during the composting stage of the process, with the piles at a temperature of > 55°C for a total of 15 days. This is to make sure that all parts of the pile have been above 55°C for 3 consecutive days. Figure 3 and Figure 4 show temperature and oxygen profiles for two completed windrows.

In our experience it takes around a day for the piles to return to temperature after being turned. This means that it actually takes longer than 15 days to complete the active composting stage. This can also be seen in Figures 3 and 4.

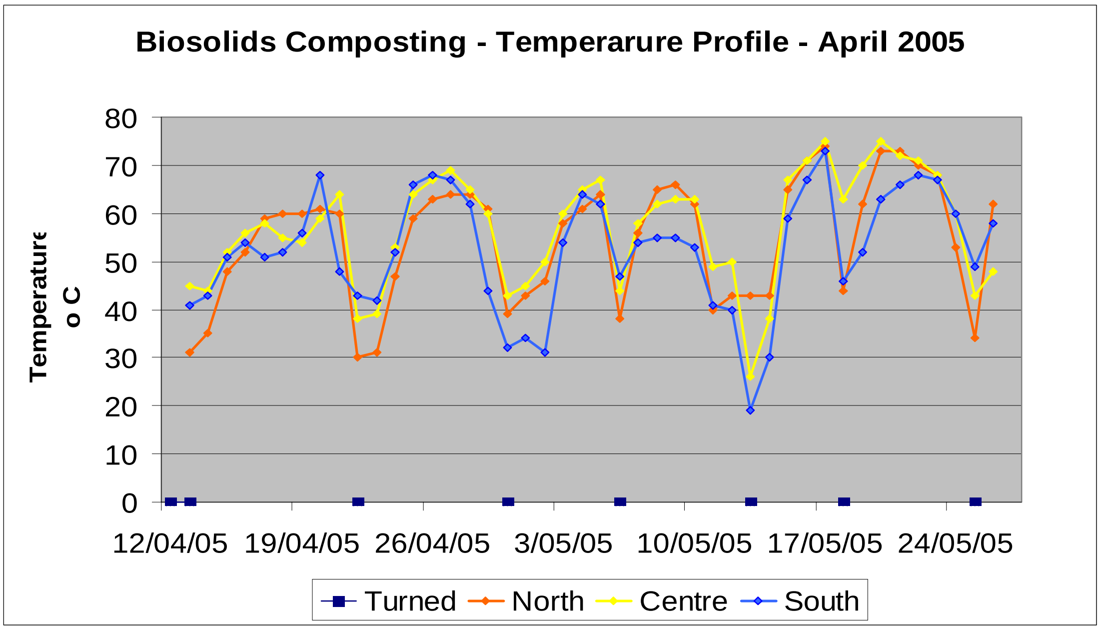

Figure 3: ***Windrow temperatures taken at two places in the pile showing the temperature time relations to produce compost.***

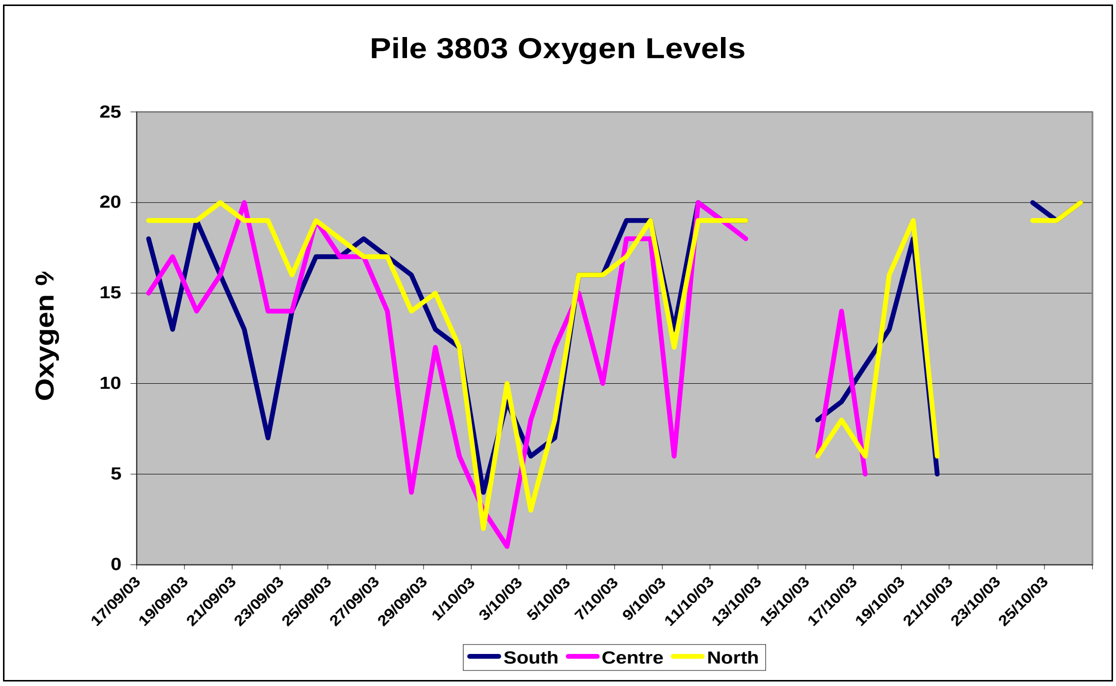

Figure 4: ***Windrow oxygen levels for one of the piles. Note the periods of low oxygen levels. This was associated with some odour development and also decreased temperatures. Recommended oxygen level for composting is >15%.***

3.2 Maturation

Once the active composting is finished the smaller piles are pushed into larger piles for maturation. Temperature is still monitored and piles are turned regularly if the temperature exceeds 70°C to prevent charring of the materials. This is continued until the temperature decreases indicating that the full composting process is complete. Without the maturation phase the compost may be toxic to plants.

3.3 Screening

The matured piles have been screened using a shaker screen (Figure 5) with the wires set at 10mm. During the screening process some of the contaminants are removed. If the screening is done on a windy day most of the plastic is blown out. This makes a bit of mess on the site and the adjacent paddocks. Some sort of fence would be useful to catch the plastic.

Large wood chips that are screened out are used to seed the new piles as they already have white rot fungi developed on them. This seems to activate a new pile in a day where as normally it could take three to four days before temperatures in the pile begin to rise as the microbes develop.

A more desirable final product could be produced if a clean, properly sized green waste could be sourced or the green waste is cleaned and shredded to the optimal size before being used.

Figure 5: ***Screening of the final product***

4.0 TESTING OF THE FINAL PRODUCT

An important test for compost is to check that the product isn't toxic to plants. Plant phytotoxicity testing was done using radish seeds. Four trays of 12 seeds were prepared. One of a brand name seed raising mix purchased from the local hardware store, one of sandy soil from the site, one of compost and one of 1:1 compost: sand mixture.

A single seed was sown in each compartment of the tray and allowed to germinate and grow until the first true leaves had formed, approximately three weeks. The seedlings were then removed from the trays and the soils carefully cleaned from the root systems. They were then placed on graph paper with measurements so that they could be photographed and measurements taken so that plant and root growth could be compared (Figure 6).

Figure 6: *Plant growth comparison*

The most successful growth medium was found to be the compost and sand mixture, producing 100% strike rate and the best plant growth and root development. The compost and the brand seed raising mixture also produced reasonable results.

The trays with sandy soil from the site produced poor results. This was due to the sand drying out very quickly in the trays. It had very little moisture retention properties. The compost alone tended to shed the water and it took a long time for water to soak into it. This was possibly due to the flat shape of the small woody particles in the compost. In the trays with the compost / sand mixture, the sand would have made the compost more porous allowing good moisture penetration with the compost retaining this moisture.

Trials in different applications have also been run with excellent results.

The final product has also been tested for metal and pesticide contaminants using the same tests as those required for biosolids. This was done at a NATA accredited laboratory. While the biosolid's Zinc and Copper levels were a bit high, the final compost product complied with all levels required for unrestricted reuse.

5.0 PRODUCT USE

At this stage the intention is for the product to be used in the agricultural operations at the site. The goal of the operation is to produce a marketable product. To do this particular attention will need to be applied to all steps in the process.

We have also conducted some informal trials with Gippsland Water staff using the product for gardens, lawns and as a potting mix, with good results.

6.0 THINGS WE HAVE LEARNED

- The compacted road base material has proved to be unsuitable because some of the stones in the road base material end up contaminating the piles due to the stones being picked up by the loader bucket and being added to the piles. Wind also caused problems by blowing small stones and pebbles onto the surface of the windrows. To try and overcome this, composted material was allowed to build up over the gravel base to form a new work surface, which was effective, but tended to become sloppy during wet weather.

- The green waste needs to be clean and of an even size with no logs or branches. While not all plastic can be removed, the less the better. If the green waste contained too much larger, woody material, the piles stayed active for a lot longer as this larger material took a lot longer to break down. This meant that the composting area would need to be larger because the piles were on the composting pad for longer. Having a clean green waste stream that is properly sized to requirements would mean the time needed to compost the products was kept down and a smaller composting area is needed.

- Don't over mix the shredded green waste and biosolids too much. Over mixing at the initial turning, more than three passes of the turner, causes the biosolids and the green waste to mash into clumps and forms a sort of paste that tends to become anaerobic and is difficult to break up. If these clumps were not broken up the centre did not compost and when broken apart contained raw biosolids. By only mixing the piles with 3 passes this does not occur.

- Application of water can be difficult. Water had to be applied slowly or it would just run off the surface of the pile with little penetration. Water is applied just before turning so the moisture on the surface of the pile is mixed through. The wind at the site also causes problems when adding water and so water is not added during high wind conditions.

- Odour has not been a problem. The biosolids themselves are very odorous when delivered to the site but once mixed in with the green waste the odour disappeared fairly quickly, developing into just an earthy smell within a few days.

- Open windrow composting can be effected by weather conditions which can cause difficulties in trying to control the process. High rainfall events caused high moisture which can cause anaerobic conditions to develop in the windrows. High wind was also a problem, blowing unwanted debris and stones onto the piles and drying the piles out in summer months. Daily temperatures had little effect on the compost, with the piles reaching composting temperatures no matter what the ambient air temperature was.

- The final product is of a good quality and has produced good results in trial applications. Most of the compost produced so far meets the composting standards for reuse.

7.0 WHERE TO NEXT

Gippsland Water is currently doing research and development trials, composting other waste streams such as grease trap wastes, contaminated soils and dairy wastes. These trials so far have been successful and will continue with other waste streams to determine their suitability for composting and whether these products can be made into a usable product.

In vessel compost is also being investigated for the treatment of some waste streams. In vessel composting can produce a higher quality product as moisture, oxygen and temperature conditions during composting can be continually monitored and controlled, there is no effect from weather conditions, there is guarantee of 100% pasteurisation and all air emissions and odours are captured and controlled. Composting times can be minimised as the whole of the compost is kept at temperature rather than just the core of the pile as with open windrow composting.

Presently, all of the product being produced is used in the agricultural side of the operations as a soil conditioner to add body and nutrients to the very sandy top soils that are at the site. The process will continue to be developed, ultimately to produce a quality product that can be sold as compost, blended into topsoil for landscaping, or possibly even bagged and sold as a potting mix.

8.0 CONCLUSIONS

Composting represents a way of value adding to biosolids and can convert a relatively unpleasant, difficult to handle product, to a friable pleasant smelling easy to handle product that can be used beneficially and is environmentally friendly. Composting also represents a way of turning other waste streams that have no value and are generally sent to landfills into a reusable and possibly marketable product.

9.0 ACKNOWLEDGEMENTS

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