Organic waste free pulpmill through vermicomposting - The Kinleith way

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ABSTRACT

Kinleith Pulp & Paper plant at Tokoroa is recycling 50,000 to 70,000 wet tonnes of primary clarifier and secondary sludges at an organic certified vermicompost plant per annum. In the first year of operation 30,000 tonnes of sludges and wood ash were diverted from Kinleith landfill. This volume estimated to represent about 10% of New Zealand's total organic wastes being diverted from landfills nationwide. Kinleith Worm Farm Ltd is now operating with more than half a billion compost worms in its second year. The worm farm is located on previously vacant mill land and on an organic dairy farm close by. All secondary sludge is being combined with primary clarifier sludge and fed to the worms. The worm farm benefits both the environment and pastoral farming: for Kinleith pulp & paper plant by avoiding the previous need for disposal to landfill and for farmers by increasing the organic content of pasture soils and reducing the requirement for fertilisers such as urea. Increased carbon may be sequestered morefrom the atmosphere through improved grass and root production.

Keywords: pulpmill solids, vermicomposting, land application.

INTRODUCTION

Kinleith Pulp & Paper plant has made majors changes to its waste management strategy, The 70,000 tonnes of primary and secondary solids that was previously disposed to their landfill is now used for vermicomposting and land application. Rising landfill costs and associated environmental and political concerns on the negative effects of disposing organic material to landfill led to the evaluation of sustainable strategies for recycling of pulpmill solids to achieve the intent of the New Zealand Waste Strategy (MfE, 2002; MfE, 2006). Kinleith Pulp & Paper plant started their journey towards being an organic waste-free pulpmill in April 2009 This goal was achieved in November 2010.

Vermicomposting is used worldwide for fragmentation and stabilisation of pulpmill solids. Usually pulpmill solids are added to nitrogen rich organic wastes such as biosolids or fruit wastes as a carbon or fibre source to enable compost worms to feed on both waste streams. Noke Ltd has conducted trials to develop a sustainable and economic vermicomposting technology for vermicomposting pulpmill solids from Kinleith Pulp & Paper plant without relying on external nitrogen sources.

More than 20,000 ha have been converted from pine forests to dairy land in the South Waikato Region over last three years. These soils are extremely low in organic matter with a very low nutrient holding / exchange capacity. Vermicompost is well known for it beneficial

use in cropping and pasture systems (Arancon *et al*., 2005; Padmavathiamma *et al*., 2008; Suthar, 2009; Tejada and Benidez, 2010).

MATERIALS AND METHODS

Kinleith's pulpmill solids

Pulpmill solids of Kinleith Pulp & Paper plant vary in their nutrient content (Table 1) making it difficult for continuous vermicomposting technologies, which are highly reliant on consistent feedstock for compost worms. The so-called primary solids are generated as sediments at a clarifier and pumped from there into two sedimentation ponds. These ponds are emptied after sludge has dewatered according to weather conditions. In summer dry matter can increase to 23.5% whereas in winter dry matter can drop to 5.5%. The carbon to nitrogen ratio (C/N) varies from 80 to 247. Kinleith pulpmill solids are very high in calcium and sulphur content, which makes the fibre an suitable feedstock source to compost, worms. Metals concentrations are well below Grade 'a' limits of the Biosolids Guidelines (NZWWA, 2003).

Table 1. Properties of Kinleith primary pulpmill solids and MyNoke vermicompost from Kinleith Worm Farm.

Parameter	**Kinleith Pulpmill Solids***	**MyNoke ™ Vermicompost**
Nutrients [g/100g dry wt]		
Dry Matter	5.5 – 23.5	41.4
Carbon	35.3 – 47.1	26.5
Nitrogen	0.19 – 0.56	1.06
C/N ratio	80 - 247	25.0
Nutrients [mg/kg]		
Phosphorus	420 - 550	815
Potassium	150 – 320	1,177
Sulphur	2,230 – 4,210	20,000
Magnesium	931 – 1,160	4,380
Calcium	33,700 – 57,400	121,000
Metals [mg/kg]		
Arsenic	ND	7.0
Cadmium	ND – 0.5	0.50
Chromium	48 - 77	26
Copper	22 - 30	53
Lead	5 - 10	38
Mercury	ND	0.12
Nickel	24 - 72	14.2
Zinc	64 - 147	129

* Data provided by Kinleith Pulp & Paper plant

Vermicomposting

Vermicomposting of pulpmill solids is a natural, self-sustaining and economic technology and has been studied internationally for more than 30 years very successfully (Elvira et al. 1997). Several authors have published their results in vermicomposting pulpmill solids with biosolids (Elvira et al. 1995; Dominguez *et al*, 2000), animal manure (Arancon *et al*, 2008), and other nitrogen rich wastes (Quintern, 2009). Kinleith Worm Farm is the only commercial vermicomposting plant known to process pulpmill solids without using an external nitrogen source.
Vermicomposting is an aerobic process and requires strict avoidance of anaerobic conditions at any time. Aerobic decomposition of the organic matter in the feedstock leads to carbon dioxide emissions and avoids emission of methane and nitrogen dioxide, which are highly relevant green house gases (GHG).

Further details on vermicomposting of pulp and paper solids are summarised in these proceedings (Glasner and Quintern, 2011).

Vermicomposting operation

Kinleith Worm Farm is operating on approximately 20 ha within a radius of 6 km from the source of pulpmill solids. Mechanical processing is minimised to reduce carbon emissions from vermicomposting. An advanced windrow technology has been developed to process an organic certified vermicompost. Beside compost worms Kinleith Worm Farm is breeding and marketing earth-dwelling earthworms, which will be used for the inoculation of low-fertile pasture soils with lowsmall numbers of earth worms.

The results from the first trials of applying dairy effluent on top of the pulpmill solids windrows appear promising. The purpose of combining dairy effluent with vermicomposting is to capture nutrients over winter months and minimising nitrate leaching while generating a high value vermicompost on site.

All activities and inputs are monitored. It is intended that all land application of vermicompost will be documented in a GIS based monitoring system allowing traceability of all applications, and to review the long term effects of land application of vermicompost derived from pulpmill solids.

LAND UTILISATION OF VERMICOMPOST AND FUTURE VISION

Currently dairy farmers in the Kinleith region are applying vermicompost at application rates of 5 t/ha. The estimated production of vermicompost at Kinleith Worm Farm could benefit 5,000 to 10,000 ha of pasture when applied annually. With the application of vermicompost a semi stable (slow releasing) carbon source is added to soil. In total 4,000 to 5,000 tonnes of carbon will be added to pasture soils in the Kinleith region per year as vermicompost. Trials involving the mixing of vermicompost with lime and/or fertiliser such as RPR, have been successful and will reduce application costs significant.

Kinleith Pulp & Paper mill is considering diverting its recycled paper solids from incineration to vermicomposting. The recycled paper solids are extremely low in nitrogen and may contain higher levels of metals as recycled paper solids are derived from inked paper and cardboard.

Recapturing of land filled pulpmill solids for vermicomposting could generate new landfill capacities and extend resource consents for existing land fills.

Combining external nitrogen rich wastes from food processing industries would increase the nutrient value of the vermicompost and would add benefits to all primary sectors and industries. Municipal biosolids could be considered being co-vermicomposted on a non-organic certified site in the Kinleith forest.

Vermicomposting is an efficient and economic way to process pulpmill sludges. The vermicompost derived from pulpmill solids is highly sought after by dairy farmers, for use as a dressing for pasture after sowing and to improve root growth for suppressing grass grub damage to pasture. The New Zealand primary sectors' demand for organic soil conditioners will very likely increase in the near future to improve natural soil fertility and increase water and nutrient holding capacity.

Initial trials of adding vermicompost from pulpmill solids to potting mixes and seed raising mixes have shown promising results. Compost worms have been fed to free range hens with great results and offer additional benefits of vermicomposting industrial wastes for producing high quality protein feedstock for animals.

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