Beneficial Use of Biosolids

Keith Nicholle, *Treatment Plant Operator,* Bundaberg City Council
Graham Campbell, *Proprietor*, Camreay Holdings
Kerry Dalton, *Environmental Officer (Water and Wastewater),* Bundaberg City Council

ABSTRACT

Bundaberg City Council and Camreay Holdings have been working together to find a long term environmentally sustainable option for the re-use of biosolids. This paper examines the cradle to grave process of turning a waste product into a beneficial resource. The paper will be jointly presented by Keith Nicholle, Millbank Wastewater Treament Plant Operator and Graham Campbell, Proprietor Camreay Holdings. The first section of the paper will present the operators perspective of treatment processes and transportation of biosolids. The onsite composting process and potential for future developments and opportunities will be discussed by Camreay Holdings in the second section.

INTRODUCTION

Changes to environmental legislation have led to more rigorous conditions being placed on the management of Wastewater Treatment Plants and associated byproducts. As a consequence of these changes Bundaberg City Council's latest EPA licence has specifications relating to the management of biosolids waste. These conditions include a requirement that biosolids should not be disposed of or stored onsite; and that a waste management program be developed identifying waste management strategies with a focus on more efficient use of biosolids. This has led Council to re-evaluate the way in which biosolids storage and disposal is carried out.

A tender for "Beneficial use of Biosolids" was advertised and Bundaberg City Council entered into a contract with Camreay Holdings to remove all of the biosolids from Council's Wastewater Treatment Plants. The program has commenced with the removal of biosolids from our two largest Wastewater Treatment Plants at East and Millbank.

DISCUSSION

Producer

Bundaberg City Council currently operates four wastewater treatment plants (WWTP) of which approximately 90% of the biosolids produced are removed and re-processed for agricultural purposes. The focus of this paper will be the East and Millbank Wastewater Treatment Plants.

Treatment of wastewater at the East WWTP is achieved by way of two Biological Trickling Filter process streams and a Continuous Extended Aeration process. Raw sewage arrives at the Inlet from the East Bundaberg catchment at a total Average Dry Weather Flow (ADWF) of approximately 6.0 ML/D. The wastewater passes through the inlet distribution chamber where the flow is split to either the A and B plant biological trickling filters or the C plant continuous extended aeration stream. The normal flow distribution is 1 ML/D to A plant, 2 ML/D to B Plant with the remaining 3 ML/D going to C Plant.

The A & B Plant process stream is further divided with the inflow passing directly into the respective primary sedimentation tanks for gravity settling. The biosolids stream from the primary sedimentation tanks is transferred to the primary digesters for stabilisation. Volume balancing from the primary to secondary digesters occurs during the biosolids transfer.

Waste Activated Sludge (WAS) from C Plant is pumped from the Continuous Aeration Ditch (CAD) to the sludge thickener. The thickened sludge is then transferred to either of the A, B or C Plant digesters for stabilization, prior to dewatering on the sludge drying beds. The dewatered biosolids from the drying beds is stockpiled in a clay lined, bunded, hard stand area onsite awaiting collection and disposal. Filtrate from the bunded area is pumped back to the inlet. Camreay Holdings then collects the stockpiled biosolids from the hardstand area and transports it to the farm for reprocessing.

Millbank WWTP is an extended aeration plant with an ADWF of 4 ML per/day. Raw sewage arrives at the Grit Chamber from the Avoca/Branyan and Millbank catchments. Millbank WWTP also receives all septic discharges. The wastewater then passes through an aerated grit chamber and onto an auto-mechanical bar screen.

Waste Activated Sludge (WAS) is pumped from the CAD to the belt press for dewatering. The dry cake from the belt press is transferred directly onto an ERA licenced waste transport vehicle for transport to the Camreay Holdings farm. Filtrate from the belt press is returned to the CAD via a pump. Approximately 50m^3 per week is delivered in two 5m^3 loads each day, one in the morning and one in the afternoon. Delivery of biosolids is carried out from Monday to Friday. This frequency has enabled the operators to reduce odours associated with the biosolids remaining in the truck for long periods of time. Table 1 indicates the quality of the biosolids from both the Millbank and East WWTP's with comparisons to the New South Wales Environmental Protection Agency (NSWEPA) guidelines (2000).

Table 1: ***Quality of biosolids***

	Parameters	NSW Guidelines Gradings [1]				East Top Beds	East Bottom Beds	Millbank
		Grade A (mg/kg)[3]	Grade B (mg/kg)[3]	Grade C (mg/kg)[3]	Grade D (mg/kg)[3]			
Total	Arsenic mg/kg	20	20	20	20	<5	<5	5.0
	Cadmium mg/kg	3	5	20	32	<1	2.0	1.0
	Chromium mg/kg	100	250	500	600	10.0	25.0	19.0
	Copper mg/kg	100	375	2000	2000	34	310	481
	Nickel mg/kg	60	125	270	300	6.0	24.0	21.0
	Lead mg/kg	150	150	420	500	20.0	101.0	44.0
	Zinc mg/kg	200	700	2500	3500	75	424	582
	Selenium mg/kg	5	8	50	90	<5	<5	<5
	Mercury mg/kg	1	4	15	19	0.7	2.3	2.1
Pestacides	DDT ug/kg	0.5	0.5	1.0	1.0	<50.0	<50.0	<50.0
	DDD ug/kg	0.5	0.5	1.0	1.0	<0.50	<0.50	<0.50
	DDE ug/kg	0.5	0.5	1.0	1.0	<0.50	<0.50	<0.50
	Aldrin ug/kg	0.02	0.2	0.5	1.00	<0.50	<0.50	<0.50
	Chlordane ug/kg	0.02	0.2	0.5	1.00	<0.50	<0.50	<0.50
	Heptachlor ug/kg	0.02	0.2	0.5	1.00	<0.50	<0.50	<0.50
	HCB ug/kg	0.02	0.2	0.5	1.00	<0.50	<0.50	<0.50
	Lindane (BHC gamma) ug/kg	0.02	0.2	0.5	1.00	<0.50	<0.50	<0.50
	BHC ug/kg	0.02	0.2	0.5	1.00	<0.50	<0.50	<0.50
	PCB's ug/kg	0.02	0.2	0.5	1.00	<10	<10	<10

1 In the absence of guideline for the reuse/disposal of biosolids in Queensland, the guidelines published by the NSWEPA are used.

Analysis is carried out to determine the contaminant grading of the biosolids. Contaminant gradings are established based on the concentration of contaminants in the biosolids. The concentrations are then compared against the acceptance limits as prescribed in the NSWEPA Guidelines (2000). The type of industry contributing to a catchment can have a significant impact on the final end use. Typical industries discharging into BuCC's wastewater infrastructure include:

- Food processing plants
- Light industry
- Sugar Refinery mill
- Rum distillery
- Soft drink brewery

The lack of heavy industry, ultimately results in a high quality biosolids product, which is very low in heavy metals and other contaminants. High Grade biosolids allows the end user a wider scope for land application. The NSWEPA Guideline for Use and Disposal of Biosolids Products (2000) was also used as a guideline for end use application.

The characteristics of the biosolids can also vary depending on the treatment process. The advantages and disadvantages associated with the biosolids produced from both plants ultimately results in different end uses at the Farm. The primary differences between the two Wastewater Treatment Plants are listed in Table 2.

Table 2: ***Treatment plant comparisons***

Millbank WWTP	**East WWTP**
Dry weight = 14 to 16%	Dry weight = 25%
Belt Press	Drying Beds
Aerobic process	Anaerobic process
Less stable on application	Digested biosolids more stable on application
Ability to waste in any weather	Dependant on weather conditions
More prone to odour problems on application	Less problem with odour on application
Waste and dispose same day.	More time consuming waste process
Biosolids removed per week = 50m3	Biosolids removed per week = 28m3 (average)
Final use-ground application	Final use-composting
	Total capacity of drying beds-66Kl

The transportation of the biosolids from the treatment plants to Camreay Holdings farm required a separate licence under EPA legislation. Applications were made to the EPA and as part of their licencing conditions for waste transportation BuCC had to implement the following:

- spills procedures
- waste docket system (for capturing quantity and frequency of waste removed from site); and
- trucks had to be modified to transport biosolids (Sealed and covered)

In this case, EPA Waste Tracking exemptions apply as the biolsolids are being transported to a farm for use as a soil conditioner or fertilizer. Camreay Holdings were also required to comply with EPA Licencing requirements for transporting and re-processing biosolids waste. Figure 1 demonstrates the quantity of waste transported for this financial year.

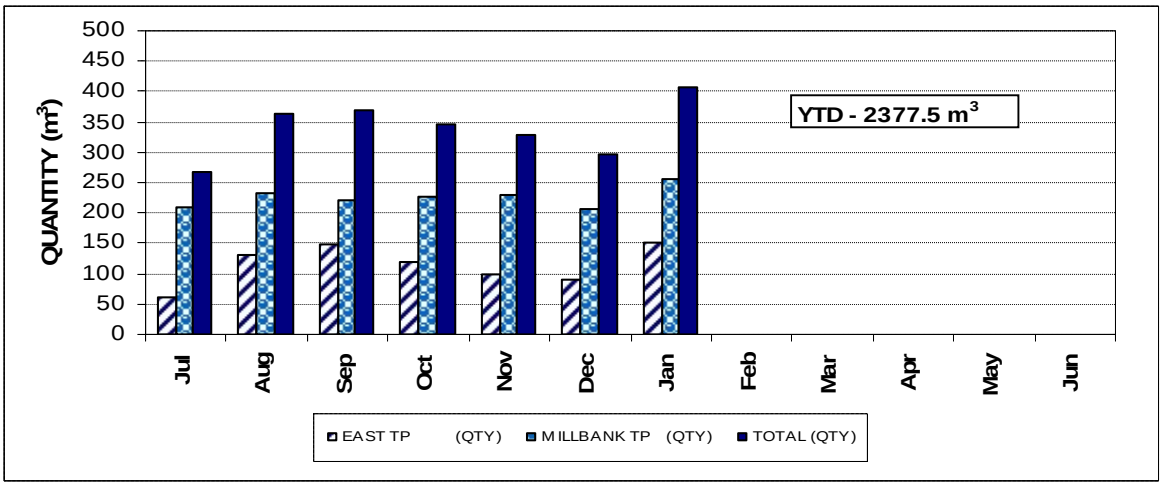

Figure 1: ***Biosolids removal***

Receiver

Prior to commencing biosolids removal Camreay Holdings had to prepare an Environmental Management Plan (EMP) for submission to EPA as a component of the application for an ERA. The EMP included aspects such as:

- Soil condition
- Biosolids quality for application
- Potential for groundwater, surface water and soil contamination
- Geographical aspects including contours and natural waterways
- Biosolids receival and composting processes
- Reporting requirements (data capture)

The biosolids cake from Millbank is land applied using a muck spreader at a rate predetermined by calculating the Carbon Limited Biosolids Application Rate (CLBAR) and the Nitrogen Limited Biosolids Application Rate (NLBAR). The application rates are as specified by the NSWEPA Guidelines (2000).

All data is captured and incorporated into the Environmental Management Plan for the Farm. Initial odour problems were overcome through a consultative process between the Operators and Camreay Holdings. It was found that odour was significantly reduced by applying and incorporating the biosolids into the soil immediately after delivery to the farm. In the case of wet weather there is a bunded ramp at the end of a private all weather road where the biosolids can be deposited until they can be applied in more suitable weather conditions.

The dried biosolids from the East Treatment Plant are transported by Camreay Holdings when there is a supply of at least 10-12 m^3. The East biosolids are combined with a prepared bed of ground up cane at a predetermined Carbon/Nitrogen ratio. When there is sufficient biosolids it is then mixed using a front end loader and windrows are formed. It is at this point that the composting process begins. The windrows are irrigated or turned as required depending on the temperature. Temperatures of between $55c^0$ and $70c^0$ are maintained for a period of at least five weeks. These temperatures are optimal for the production of high quality compost. The whole windrow must be turned and temperatures must be maintained to avoid pathogen and weed contamination of the compost. This also meets the requirements for Australian Standards AS 4454-2003, Compost, Soil Conditioners and Mulches. Figure 2 illustrates typical temperatures achieved through-out the composting process.

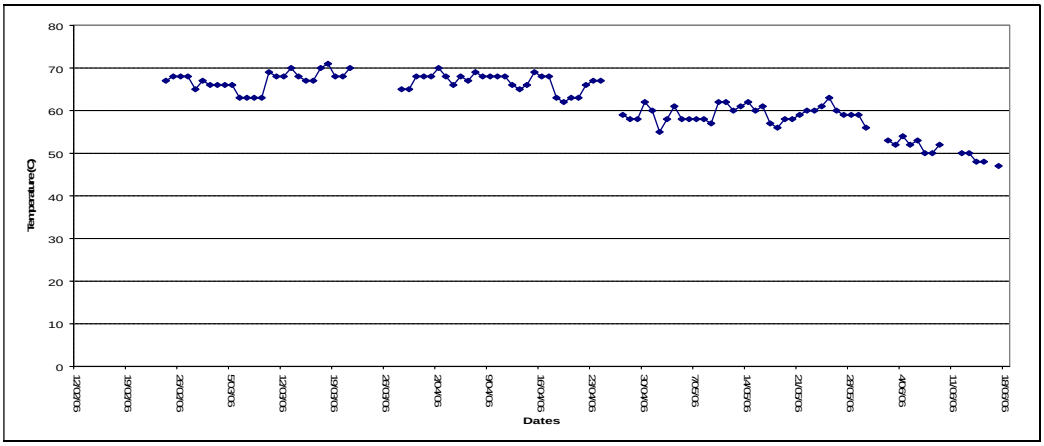

Figure 2: ***Compost Temperatures***

When the temperature drops significantly and the composting process is nearing completion, the compost is stockpiled and left to mature. This process can take up to approximately 12 weeks. After maturation a sample is sent to the Soil Foodweb Institute for analysis and grading.

An example of recent analysis is tabled below. This compost is suitable for application as a soil conditioner. Compost of this quality would increase the carbon content as well as improving soil, which has been damaged and/or nutrient depleted from over-use. High quality compost can also assist with water retention.

Table 4: ***Compost Analysis Results November 2006***

	Active bacterial Biomass (µg/g)	Total Bacterial Biomass (µg/g)	Active Fungal Biomass (µg/g)	Total Fungal Biomass (µg/g)	Hyphal Diameter (µm)	Flagellate	Protozoa Numbers/g Amoebae	Ciliate	Total Nematode Numbers #/g	Plant Available Nitrogen (from predators)
Desired Ranges	15-25	100-3000	15-25	100-300	(um)	10000+	10000+	50-100	20-30	kg/ha
Results	80.9	917	1.87	460	3.0	10026	3730	801	0.87	75-100
Suitability	Excellent	Good	Low	Excellent	Disease suppressive fungi present	Good	Low	OK	Low	

Extracted from Soil Food Web website (2007)

Camreay Holdings intends to package the compost in 20 kg bags for domestic market, as well as selling the compost in bulk to farmers. Compost of this quality can be used to produce compost tea. Other than sugar cane, which has been grown on the blocks with applied biosolids, Camreay Holdings have recently harvested a crop of sunflowers and plan to follow this with a crop of maize. This crop has been grown without the use of additional fertilizers.

CONCLUSION

Camreay Holdings and Bundaberg City Council are very passionate about being actively involved in a project that presents a long term, environmentally sustainable solution to waste disposal. The perception of biosolids is no longer that of a waste product; instead it has become a resource with a growing number of applications. BuCC Treatment Plant Operators have enthusiastically contributed to this process working with Camreay Holdings to overcome any problems and issues which may have arisen during the initial inception.

As partners BuCC and Camreay Holdings are excited about the future of sustainable use of biosolids. Camreay Holdings believe that the future lies in liquid biosolids and as a recycler and end user, this is an option that is being explored with interest. It is the belief of BuCC and Camreay Holdings that through a collaborative approach by producers and end users, a best practice process to beneficial re-use of biosolids could be achieved at a National level.

ACKNOWLEDGMENTS

The authors would like to acknowledge Bundaberg City Council for their contribution to this paper.

REFERENCES

Australian Standards Committee CS-037, Garden Soils and Potting Mixes, 2003, *Compost, Soil Conditioners and Mulches*, Standards Australia International LTD, Sydney.

NSWEPA, 2000, *Environmental Guidelines: Use and Disposal of Biosolids Products*, Environment Protection Agency, Sydney.

Soil Foodweb Inc., 2007, "Good Quality Compost" on *Soil Foodweb*, http://www.soilfoodweb.com/