

Composting Technologies In The Cities Of Colombo, Kandy And Dambulla, Sri Lanka

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EXECUTIVE SUMMARY

This paper focuses on the composting programs in the cities of Colombo, Kandy, and Dambulla, Sri Lanka in 2004. All of these sites have composting experience. All have made improvements to their composting systems. All have clear opportunities to further improve their composting systems in the future. Observations for each of the cities' composting programs will be presented and some issues that need to be addressed will be raised.

Composting is a technology that can process a portion of the solid waste stream to reduce pathogens, lower odors, reduce the viability of weed seeds, improve the physical properties of the material, reduce both volume and mass, increase the chemical stability of the material, and produce a product that has beneficial uses in agriculture, horticulture, and forestry production. Compost can be used in environmental protection and reclamation projects. Compost is valuable in soil erosion reduction efforts. Composting technology can be adjusted to work in both rural and urban areas. Composting technology is well suited to Sri Lanka. This is because the solid waste stream in Sri Lanka typically contains 50% to 85% compostable materials. Many of the crops grown in Sri Lanka have been shown to benefit from the application of good quality compost. Especially important is the work of the Sri Lanka Tea Board (SLTB) and Tea Research Institute as to the value of compost in maintaining high quality tea production. Many private sector companies know how to use compost in horticulture, landscaping, rice and coconut production.

Public health and safety issues, including: air pollution; disease control; safe drinking water; and waste reduction require the establishment of an effective solid waste management system. The environmental quality of the nation, including the restoration and protection of air, water, soil, and species, can benefit from compost utilization. Economic and development issues require Sri Lanka to establish a national integrated solid waste management system that has sufficient and sustainable funding. Composting can play a major role in this overall system. Profitability and uniformity of regulations remain to be proven.

INTRODUCTION

Sri Lanka is a tropical island nation. It is located between Latitude 5 55' N to 9 50' N and Longitude 79 42' E to 81 52' E off the southern coast of India. It has a surface area of 66,000 square kilometers. The current population is about 20.7 million people. The Sri Lankan people are friendly, hospitable, and optimistic. The estimated annual population growth rate is 1%. The ethnic makeup of the country is 74% Sinhalese, 17% Tamils, 7% Moor, 2% European and all others. The major languages are Sinhala, Tamil, and English. Religious preference is 69% Buddhist, 15% Hindu, 8% Muslim, 8% Christian, and 1% others. The national government has been a socialist democracy since 1948.

The Gross National Product for the year 2000 was over \$USD 50 billion. Major products and services include: clothing, textiles, transportation, tea, tourism, coconuts, rubber, tobacco, rice, sugarcane, grains, pulses, oilseed, spices and gems. Major trading partners include: Australia, Belgium, China, Germany, Hong Kong, India, Indonesia, Iran, Japan, Netherlands, New Zealand, Portugal, Russia, Singapore, South Korea, Switzerland, Taiwan, Thailand, United Kingdom, and the United States of America.

The country is famous for its 1,600 kilometers of beautiful beaches. It is a wondrous island, with several climatic zones that support a wide diversity of plants and animals. Because of its geology, soils, climate, and unique ecology, in many ways, it is a "paradise" island. While this description is accurate it contrasts markedly with the economic poverty, environmental degradation, open dumping and burning of solid waste that is also widely present in the country today.

The proper management of solid waste is a major issue for Sri Lanka. This is not a "new discovery." Many people, programs, organizations and agencies have previously identified solid waste management as being very important including: The City of Colombo Economic Development Plan; United Nations Human Settlements Programme; United Nations Department for Policy Coordination and Sustainable Development; The World Bank; The Asia Pacific Cities Forum (APCF); the Urban Development Authority (UDA); foreign government development programs (e.g. New Zealand, Fraser Thomas and Sean Finnigan; Japan, JICA; United Kingdom; Netherlands; etc.) and numerous university studies (e.g. Humboldt Universität, Berlin; University of Minnesota; etc.); private consulting firms (e.g. SCS Engineers, Long Beach, CA, etc.), Non-Governmental Organizations (NGOs) reports (There are currently more than 2,000 NGOs operating in Sri Lanka), and many articles. The problem has become more difficult due to rapid urban growth, recovery after a long civil war, low income, learned behaviors, an extremely fragmented solid waste management approach and other competing issues including a devastating tsunami on December 26, 2004 that added millions of tons of additional waste to the already overloaded waste management system.

The national government in Sri Lanka includes the Parliament; the President; and the Courts. The Ministry of Forestry and Environment (MFE) and the Central Environmental Authority (CEA) are primarily responsible for national policies regarding solid waste. There are nine provinces and twenty-four administrative districts. At the local level there are Pradeshiya Sabhas, Municipal and Urban Councils, and Grama Seva Nildaris. What little solid waste management is done is typically done by a Public Health Inspector at the local level often with the support of a NGO, or a foreign aid project. Every case is unique.

Laws and regulations pertaining to solid waste include the National Environmental Act, the Pradeshiya Sabha Act, and the Urban Council and Municipal Council Ordinances. The Environmental Act restricts the emission of waste materials into the environment, and states the responsibilities and powers of the CEA. The local Government Acts and Ordinances state that the local authorities are responsible for proper removal of non-industrial solid waste, and for providing "suitable" dumpsites and other needed waste management facilities and services. The current sites used for dumping are often not environmentally suitable. Funding mechanisms for solid waste management at both the national and local levels are currently inadequate.

This paper comes out of the presentations and interactions based on a series of compost capacity building workshops presented in Dambulla, Kandy, and Colombo. The workshops were presented on March 17, 2004 in Dambulla, on March 18, 2004 in Kandy, and on March 19, 2004 in Colombo. On March 23, 2004 a lecture on "Critical physical, chemical and biological parameters to make quality compost" was given to the Sri Lanka Association for the Advancement of Science (SLAAS), Colombo, Sri Lanka.

Colombo

Colombo is the largest city in Sri Lanka today. It is the center of economic, political, and cultural activity for the country. It has a population of about 990,000 people and a working population of more than 1,300,000. The surface area of the City of Colombo is 3731 hectares. The Colombo Metropolitan Region (CMR) includes the districts of Colombo, Gampaha and Kalutara and the Municipalities of Colombo, Kotte and Dehiwala, and others. The population of the CMR is approximately 6.5 million people or a little more than 31% of the total population of Sri Lanka. The national capital is Sri Jayewardenepura Kotte, which is located about 13 kilometers from the City of Colombo and is in the CMR.

The Colombo Municipal Council (CMC) is the local authority that governs the City of Colombo. Established in 1865, the Colombo Municipal Council has fifty-three members elected for four-year terms. The mayor is the Head of the Council. There are about 9,000 employees at the CMC. In 2005 the CMC announced that it is focusing on reducing the quantity of MSW in Colombo by encouraging people to sort their garbage such as food waste, plastics, glass and papers in different bags. The CMC has announced the goal of reducing MSW collections from the current 650+ tons per day to 500 tons per day over next five years.

Solid waste collection and disposal has been an issue in Colombo for a long time. According to the solid waste study done by the National Building Research Organization of Sri Lanka, none of the usual methods of treatment such as size-reduction, composting or incineration were carried out on a regular basis before November 2002. Before that date, municipal solid waste (MSW) was disposed of in open dumpsites or simply abandoned. Unfortunately that is how most of the solid waste is still managed today. Most of the canals and other surface waters in Colombo are highly polluted. The polluted waters tend to encourage people to throw their household solid waste into the water because they see that it is already polluted. Many people built their toilets to discharge directly into the surface waters. So the surface waters of Colombo are polluted not only by solid waste, but also by wastewater, raw human waste, and industrial waste. It is difficult to know where to begin.

There are no "modern sanitary landfills" in the country. The CMC has recognized the importance of recycling and reuse. According to the municipal engineering department,

composting has been proposed by at least sixteen studies using compost technologies to process a portion of the MSW stream. Several pilot projects were conducted by the CMC to test the financial and marketing feasibility of large-scale compost production over the past fifteen years. On June 5, 2000, the national government through the Ministry of Forestry & Environment developed and adopted a 22-page plan entitled, "National Strategy For Solid Waste Management."

Nationally there has been some progress during the past three years. However, basic infrastructure, scientific regulation and sustainable financing are still lacking. Uncontrolled littering, dumping and dangerous low temperature burning of waste is widespread. Open burning of waste contributes to atmospheric pollution and causes serious health problems. Many of the dumping sites are physically located in wetlands, saltwater estuaries, stream banks, and gullies. Dumping solid wastes in these sensitive natural areas pollutes both ground and surface waters. Facilities for final disposal of most of the solid waste produced by households and businesses are not up to "best available" technical standards. Waste that is improperly dumped can impede water-flow in drainage channels, and provides breeding places for disease vectors such as mosquitoes and rats. Poor solid waste management practices have been identified as one of the major factors restricting the development of the tourist and eco-tourist sectors in Sri Lanka.

Since 1995, the Burns Trading Company (Pvt) has contracted with the CMC to provide some types of MSW disposal services to the city. Burns Trading Company (Pvt) came to the conclusion that a new company with greater technical capabilities would be required if the issues of MSW collection, processing, environmental protection, and long-term agricultural sustainability were to be successfully addressed. With these goals in mind a new company was formed named Burns Environmental & Technologies (Pvt) Ltd. (BETL). Since 2000 BETL has invested more than \$USD 6 million in compost equipment and operations. On March 21, 2001, the CMC contracted with BETL to develop a system of MSW processing that would meet the requirements of the city and be consistent with the "National Strategy For Solid Waste Management" plan for a period of twenty-five years. As a part of this contract, BETL began processing MSW as compost on November 1, 2002 at the Bloemendhal Road site.

The BETL system includes collection containers, trucks, routing, collection, and dumping on to a concrete sorting floor that is covered with a full roof to give protection from the rains. The re-cyclables are put into types and grades of metal, cardboard, paper, and glass. The compostable materials and plastics are put into static piles ~ 3 meters high. Free liquid is collected from the piles and put into storage tanks. Temperatures are taken at three locations in each pile, each 8-hour shift and are recorded. The turning and mixing of the piles is based on the time and temperature of the individual pile. After 4 to 21 days the piles are moved to a composting site where the material is put into long inverted U windrows on a concrete floor, under a full roof. A free water drainage system is designed into the floor. The roof keeps the rain off of the piles. The piles are monitored for temperature, moisture, and free air space. The piles are then mixed and moved every 14 to 28 days. After a total of 60 to 120 days the material in the piles are screened and sorted to remove plastics and other contaminants. Next the compost is processed through a set of progressively smaller tromel screens with magnetic separators before and after each screen. The sized compost is then moved to a warehouse where it is blended and bagged for specific crops. The finished compost is sold to both dealers and directly to farmers and landscape companies.

Sawdust, bark, lumber trimmings and other dry, coarse, organic materials should be used as bulking agents to increase free air space and reduce odors. Sawdust can be mixed into the compost material up to 10% by volume. Coconut and storm damage wood wastes can also be used for this purpose. High carbon bulking materials should make up at least 15% - 25% of the total feedstocks going into the system. This would increase the cost of producing compost however it would result in a system with lower odors and better quality compost.

Real progress was made from 2003 to 2004 in the composting of MSW in Colombo. BETL collected and processed from 600 to 1,100 tons of solid waste per day in 2004. They sorted recyclables and composted from 130 to 750 tons of solid waste a day. Their production of finished compost products went from 130 tons to over 600 tons per month. They developed six compost products designed for specific crops and uses. The quality of all of the products improved. BETL implemented a number of the technical improvements into their current process controls. They built a Quality Assurance Laboratory building at the Sedawatte site. They acquired scales, a drying oven, temperature probes, and some of the other required laboratory equipment. They are collecting data on batch samples on a daily basis. BETL is planning to have the "full" Quality Assurance Laboratory up and running by the end of 2005. In addition, BETL developed three new innovative compost products. They are exploring the possibility of securing patents on these products both in Sri Lanka and in other countries. BETL hopes to establish eight additional composting facilities in other urban areas, including Galle, Kurunegala, Anuradhapura and Trincomalee during the next five years.

The cost of production is currently too high. Current revenues are too low. Efforts need to be directed toward increasing the amount of "clean" source separated feedstocks. But having more source separated compostable feedstocks would likely mean a more frequent collection schedule which could add significantly to the total cost of the operation. Collection accounts for 60% - 70% of the total cost. The \$7 per ton tipping fee in 2004 was not sufficient to remove contaminants, such as plastics, metals, and glass in an environmentally sound way. For a composting company to operate, revenues need to increase to the range of \$14 to \$21 per ton. In the meantime, both labor costs and equipment costs need to be further analyzed. The sale of the finished compost products is not sufficient to support more than about 10% - 15% of the total costs. A combination of collection fees, tipping fees, processing fees and sales of recyclables and compost will be needed if this type of operation is to be economically sustainable.

In April 2005 there was a contract dispute between BETL and the CMC. The outcome of this dispute was not known at the time this paper was written.

The CMC in 2005 announced a pilot project to encourage at-home backyard composting in 300 households. This new program is aimed at cutting down waste generation and addressing escalating garbage disposable problems. This is a good idea and should be encouraged, but in a densely populated urban city with almost 1 million people, this approach will be unavailable to most people and it is too small in size to make any real difference. Even with a massive educational and incentive program, it is unlikely to achieve more than 7% participation.

With some 6,500,000 people living in the CMR, and assuming a municipal solid waste generation rate of 1.00 kg to 1.26 kg / person /day, the CMR needs to plan for a solid waste collection and processing system that has a capacity between 6,500 to 8,200 tons per day (tpd). This is a very difficult task! Plastic material (5%-12%) and other

combustibles (1,000 – 1,250 tpd) from the solid waste stream could be used to fuel a solid waste energy recovery system that could provide 35 mw to 70 mw of electricity into the national power grid. Using Best Available Technologies (BAT) to minimize air pollution, estimated capital costs for such a facility are in the range of \$USD120 million to \$USD160 million. If compostable organics percentages remain the same as today there will need to be facilities in place to compost 5,000 tpd. (Currently, the largest MSW composting facility, located in Edmonton, Canada, is 1,200 tpd.) In total, to adequately handle the solid waste CMR will need four or more large compost facilities, at least one modern state-of-the-art lined landfill for residuals, an electrical generator fueled primarily by plastics and combustible wastes, and an effective medical waste processing system. This is a very challenging undertaking!

The issues facing the City of Colombo include: existing practices; extreme fragmentation of regulations and enforcement; lack of funds; reluctance to impose new taxes or fees; vacillation as to who should conduct the management of solid waste -- the government or the private sector; identifying how they can benefit from NGOs and Foreign Government aid programs; and deciding if there should be a single unified national solid waste management system.

Kandy

Kandy (also known as Senkadagalapura) is located near the center of Sri Lanka and for many people it remains the cultural and religious center of the country. Kandy was the capital of a Sinhalese kingdom from 1592 to 1815. The Temple of the Tooth, located in the center of the City, is a famous pilgrimage site for Buddhists worldwide. Kandy had 110,049 people in the 2001 census and is estimated to have about 165,000 people today. The greater Kandy metro area has a population of about 350,000. The City of Kandy produces about 150 tons of MSW per day with 60% - 76% being compostable. The metro area produces about 385 tons of MSW per day with 70% - 87% being compostable.

The sponsor for this program was Chemical Industries Colombo, Ltd. (CIC). Representatives from CIC and Tom Halbach met with the Deputy Mayor of the City of Kandy, the Public Health Officer, and other city officials and staff on March 18, 2004. We discussed many issues related to the composting of municipal solid waste. It was emphasized that composting would be more likely to be successful and sustainable if food and other compostable wastes were sorted and collected separately. The collection system would need to be changed for more frequent pickups and to produce good quality finished compost products that have real market value.

The City of Kandy would like to have a 250-ton/day capacity compost facility up and running within the next year. To meet this goal, Kandy needs to develop a source separated collection system as well as hire a competent, private-sector vendor with capabilities to compost the needed volume. The site that has been proposed for the composting facility is adequate in size, has an acceptable location, acceptable accessibility, and has one of the most beautiful views of any waste processing site.

In order to operate a commercial composting facility the private-sector company will need to do many things. First, the site needs to be secured for use. Next, they will need to optimize the collection and routing of the material. Specifically, they need to supply source-separated containers to the community. The timeliness and frequency of collection needs to be improved. They need to optimize the routing of collection, which will reduce labor, increase speed, improve loading and unloading, etc. A written plan to improve operations

should be developed. Staff should keep daily written notes on various vital aspects of the operation, including but not limited to: amounts, weather conditions, feedstocks, temperature, moisture, and oxygen content. A concrete floor with a roof will need to be built. A static pile inverted U windrow system could be used. A second structure needs to be built for final screening, bagging, and storage.

After careful review and analysis CIC decided that the composting system desired by the City of Kandy was not a viable business, as it could not be profitable under the existing terms, regulations and conditions.

The issues facing the City of Kandy include: existing practices; extreme fragmentation of regulations and enforcement; lack of funds, reluctance to impose new taxes or fees, vacillation as to who should conduct the management of solid waste -- the government or the private sector; identifying how they can benefit from NGO and Foreign Government aid programs; and deciding if there should be a single unified national solid waste management system.

Dambulla

The city of Dambulla is located in the Matale district, north of Kandy. The population is approximately 65,000 people. It is most famous for its cave monastery, a sacred pilgrimage site for twenty-two centuries, and a Buddhist Golden Temple. The City produces about 67 tons of MSW per day. The estimate is that 70% - 80% of that waste stream is compostable. Dambulla is also the site for the National Vegetable and Fruit Wholesale Market. This market produces between 25 - 75 tons per day of solid waste that is 97% compostable.

The sponsor for this program was Chemical Industries Colombo, Ltd. (CIC). Representatives from CIC and Tom Halbach met with the mayor, the chief minister, and other local officials. We toured a compost site that had been operated by a local eco-hotel from 1997 until 2002. At the time of the tour this composting facility had been closed due to high costs. In talking with the former facility managers, there was agreement that if the solid waste had been source separated into a clean compostable fraction (without plastics and metals) their work would be much easier, and the finished compost products would be of much higher quality and have higher value. Under the current system even with large inputs of hand sorting of plastic films, it is impossible to produce acceptable quality compost for agricultural and horticultural use. The City of Dambulla indicated that they would like a private-sector company to develop and operate a composting facility that could process about 100 tons per day of feedstocks from both the City and the Wholesale Market. As an alternative a composting facility for only the Wholesale Market waste could be sized for 50 tons per day and would have much lower collection and logistic costs.

The CIC Agri Business Centre in Pelwehera, Dambulla was the proposed site for a source separated composting site for the Dambulla National Vegetable Wholesale Market. The Market generates from 25 to 50 tons of vegetable wastes each day. In order to operate a commercial composting facility in Dambulla, CIC will need to do many things. They will need to design and supply source separated containers for the Market. They will need to locate the collection containers at convenient locations at the Market. A collection schedule needs to be established that fits the activities of the Market, traffic conditions, and the composting facility labor and equipment availability.

CIC has a state-of-the-art soil and plant analytical laboratory and seed-testing laboratory that can be adapted for compost quality assurance. They have a well-trained staff already in place. A written plan of operations should be developed. Staff should keep daily written notes on various vital aspects of the operation, including but not limited to: amounts, weather conditions, feedstocks, temperature, moisture, and oxygen content. A concrete floor with a roof will need to be built. A static pile inverted U windrow system could be used. A second structure would need to be built for final screening, bagging, and storage. CIC has an advantage in that they have extensive experience in conducting small plot crop trials. This would help them in developing products, application recommendations, and sales of finished compost products. They already have a well-established distribution and marketing system in place to serve the agricultural sector.

After careful planning and analysis CIC decided that the composting system desired by the City of Dambulla was not a viable business, as it could not be profitable under the existing terms, regulations and conditions.

The issues facing the City of Dambulla include: existing practices; extreme fragmentation of regulations and enforcement; lack of funds, reluctance to impose new taxes or fees, vacillation as to who should conduct the management of solid waste -- the government or the private sector; identifying how they can benefit from NGOs and Foreign Government aid programs; and deciding if there should be a single unified national solid waste management system.

CONCLUSION

There are a few general principles that may help to establish a viable compost industry in Sri Lanka. Source separation of compostable wastes is a good idea. Once the compostable wastes have been mixed with "the entire solid waste stream" it becomes difficult or impossible to "clean it" into quality finished compost that has a positive market value. Collection systems need to be developed that separate the compostable materials from the start and then keep them separate until they can be composted.

Effective education programs for all staff, customers, regulators and communities are extremely helpful. Specialized equipment that can assist in shredding and mixing bulking material into the compostable waste is available and needed. This equipment can help improve the uniformity of the feedstock mix within the compost piles, resulting in better quality compost products.

While composting is a good place to start in the improvement of the solid waste management system, it alone cannot do the entire job. A requirement for achieving sustainable economic development in Sri Lanka is the establishment of an effective national integrated solid waste management system. This is especially critical for the tourism sector. Public health and safety issues, including disease control, safe drinking water, and particulate reduction, require the establishment of an effective and consistent solid waste management system. The environmental quality of the nation, including restoration, protection of air, water, land, and species, requires an effective solid waste management system. Economics, health and environmental issues all require Sri Lanka to establish an effective national integrated solid waste management system that has sufficient and sustainable funding.

Air pollution remains a very serious problem in Sri Lanka. It is bad for the health of the people. It is bad for the environment. It is bad for future economic development.

Uncontrolled open burning of solid waste from thousands of small sites and many municipal dumps must be stopped. The low temperature, short combustion time and low turbulence burning of wet solid waste produces 10 to 1,000 times more hazardous compounds than a current state-of-the-art energy recovery solid waste incinerator. The open burning of MSW sends black clouds of smoke into the air and creates a significant health, safety, and environmental risk to the people who live in Sri Lanka.

There is an excellent potential for composting to play a major and positive role in the management of municipal solid waste in Sri Lanka

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