SUCCESSFUL CO-COMPOSTING IN SEVIERVILLE, TENNESSEE

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INTRODUCTION

In September, 1992, the largest U.S. co-composting facility that can process municipal solid waste (MSW) and biosolids (MSS) was successfully launched in Sevierville, Tennessee. This plant, which is owned by Sevier Solid Waste, Inc. (SSWI), features the proprietary Bedminster technology to process residential and commercial solid waste along with all available biosolids generated in Sevier County. Accelerated population growth coupled with a growing economy based on tourism and tourism-related activities had caused a 100% increase in county solid waste volume. In order to meet future waste disposal requirements, the county formed SSWI to find an economical and environmentally sound long-term solution to waste disposal that also could meet future recycling mandates and reduce the size and scope of the landfill operation. After an extensive review, Bedminster was selected and the current Sevierville facility was built.

RESULTS

This past September, the facility completed its second year of successful operation. In the two (2) years since it opened, over 6,000 visitors have toured this facility, which is located within a few miles of the three principal municipalities in Sevier County -- Sevierville, Pigeon Forge and Gatlinburg. Together these cities form the gateway to the Great Smoky Mountains National Park, the largest U. S. national park in terms of visitors. Although designed to process 3,870 tons per month of solid waste with up to 1935 wet tons of biosolids, the actual solid waste tonnages processed have ranged from as low as 2,552 tons per month in the winter months to over 5,000 tons per month during the tourist season. **Table I** (see attached) shows the monthly tonnage of MSW processed by this plant from January, 1993, through September of this year, compared to the designed capacity of 3,870 tons per month.

In order to accommodate this increasing waste volume, Bedminster, who operates the facility for SSWI under an annual O&M agreement, has increased the operating schedule to seven (7) days a week from the originally planned five and one-half day routine. This has increased the O&M cost from $18 per ton to $22 per ton of MSW processed.

Since opening, the facility has processed all of the dewatered sludge delivered from the county wastewater treatment plants. While the facility can process approximately one wet ton of biosolids for each two wet tons of MSW, the available biosolids in Sevier County have been closer to one wet ton to each four tons of MSW generated. The proper amount of biosolids is an important ingredient to an efficient co-composting process, since it is a major source of the nitrogen that fuels the microbial activity to accelerate the process and minimize retention time. Another major source of this nitrogen in Sevier County has been the large amount of food waste in the MSW delivered to the plant. Dewatered sludge is now being delivered to the facility from a treatment plant outside of the county and more can be imported as available in future months. Combined with a moderate amount of grease trap waste generated by the many local restaurants in the area, the monthly biosolid tonnage processed by this plant from January, 1993, through September of this year are shown in **Table II** (see attached).

Once this waste is delivered to the Sevierville facility, the daily routine is initiated. When the solid waste arrives on the tipping floor, workers move in and manually pull out the items which are clearly not suitable for processing, such as cable, garden hose, plastic buckets, bricks, tires, bicycle frames and the like. This "by-pass" waste, which is generally not in garbage bags, is landfilled. The bagged garbage is loaded into the digesters without

the bags being opened. There is no grinding, shredding or hammer-milling of materials at any stage of the Bedminster process.

Inside the Eweson digesters, the garbage bags are broken open by the abrasion and tumbling action of the slowly rotating kiln-like devices. Sewage sludge and innoculant are added. The intense microbial activity in the mixture feeds on what is biodegradable and converts it into rough compost. Such non-biodegradable materials as sheet plastic and synthetic cloth remain as large pieces in this mixture. After three days in the digesters, a volume reduction of 30% is achieved. When the mixture is discharged from the digesters, it has sufficiently composted so that there is no free liquid or leachate. It then proceeds via conveyor to a trommel screen. Here, approximately 95% of the non-biodegradable materials are removed.

Immediately following the trommel is the point at which ferrous and aluminum recovery is accomplished. In Sevierville, ferrous is recovered by employing an electromagnet. Since the waste stream contains 3-3½% ferrous by weight, approximately five (5) tons are recovered each day. This is then sold for a net profit of $30 per ton, after transportation and container costs. An aluminum separation system is currently being installed. When operational at the end of this year, approximately one ton of aluminum will be recovered per day and sold to one of three local buyers for between $1,200-$1,400 per ton.

The compost that falls through the trommel is moved to the aeration floor along with smaller pieces of non-biodegradable material which provides a bulking agent for porosity in the curing piles. After six (6) weeks on the curing floor, an additional volume reduction of 25-30% has occurred. Following the curing phase, the compost is passed through a fine-screening and refinement module. This module consists of a trommel screen with multiple fluidized bed separators. Here, most of the remaining non-biodegradable materials are separated out, including glass, stones and sharps. Part of the screenings are over-sized organics, and are recycled back to the digesters to serve as inoculant.

Most of the glass is reduced to sand-sized particles in the process and this remains in the compost. Larger pieces of glass are currently landfilled until a market can be established. The remaining compost is stored for 2-4 weeks and then marketed.

A summary of the waste volumes processed by the Sevierville facility form January, 1993, through September, 1994, are as follows:

Category	Tonnage	
MSW	84,387	
MSS (including grease)	16,170	
Total Waste	100,557	
Residue	32,190	
Compost	32,067	@40% moisture level

This represents an overall average division rate in Sevier County of 68%, more than double the 25% goal suggested by the State of Tennessee for 1995. The 32% residue is computed by weight but represents a volume reduction of 80% in the landfill. Therefore, where Sevier County was filling four (4) acres per year at their landfill prior to the Bedminster facility, less than one acre is now needed each year. This was an important objective set and achieved by SSWI.

Their objective to install a process which would have low maintenance and high reliability has also been achieved. Since start-up, the Sevierville facility has had no unscheduled down time except for the four (4) days last winter when a snowstorm shut off power in the area. Even during this four (4) day period, the facility took all waste delivered. While two weeks of total shutdown for maintenance is allowed by contract each year, to date, only partial shutdown has been needed. In the first two years of operation, the plant has always accepted and processed waste above the design capacity, unless the waste was just not generated.

The two years of operation in Sevierville has also proven that biofilters, if correctly designed and maintained, can effectively control odors and eliminate odor problems. The efficiency of biofilters in removing odor can be determined by dilutions to threshold. In Sevierville, the biofilters were tested to determine removal of total odors, with the following results:

Entering Biofilter:	1020 Dilutions to Threshold
Exiting Biofilter:	6-38 Dilutions to Threshold

This odor removal rate of 96.3% from all exhaust, along with a 92.6% removal rate obtained for sulfur components and an average removal rate of 82.2% obtained for a variety of volatile organic compounds, is sufficient to reduce most odorous compounds below levels of concern, as the Sevierville facility operation experience has verified.

The final objective of SSWI was to employ a composting system that could not only handle both solid waste and biosolids, but would convert them into a high quality compost that could be beneficially used in horticultural and agricultural applications. Over the two years of operation in Sevierville, all compost produced at this facility has met all U.S. EPA 503 regulations for Class "A" pathogen reduction, vector attraction and heavy metal concentrations. This compost is, therefore, classified as "Exceptional Quality" (EQ) and is marketed and used unrestrictedly in the local agricultural and horticultural market located near the facility. The quality of this compost is summarized in the four (4) compost charts attached that show the nutrient content and heavy metal levels recorded by an outside laboratory for samples of Sevierville compost.

The analysis of nutrients and the value of actual plant food per ton of compost produced at Sevierville has been calculated based on the Florida Commercial Fertilizer Law. This evaluation is shown in **Table III** (see attached).

Most of the compost produced at our Tennessee facility is marketed to local farmers, nursery operators, landscapers and soil blenders. A portion of this output, however, must also be allocated to our ongoing university research program (i.e. University of Florida, Clemson University, North Carolina State University, Rutgers University and Louisiana State University), the development of compost markets at new plant sites, and the fulfillment of contract obligations to Sevier Solid Waste.

The breakdown of end users of our Sevierville compost over the past fifteen (15) months is as follows:

End User	Tons
Farmers	37.4
Landscapers	26.1
Sevier Solid Waste	21.4
Soil Blenders	10.0
Researchers	2.8
Nurseries/Residents	1.5
Market Development	0.8
Total	**100.0**

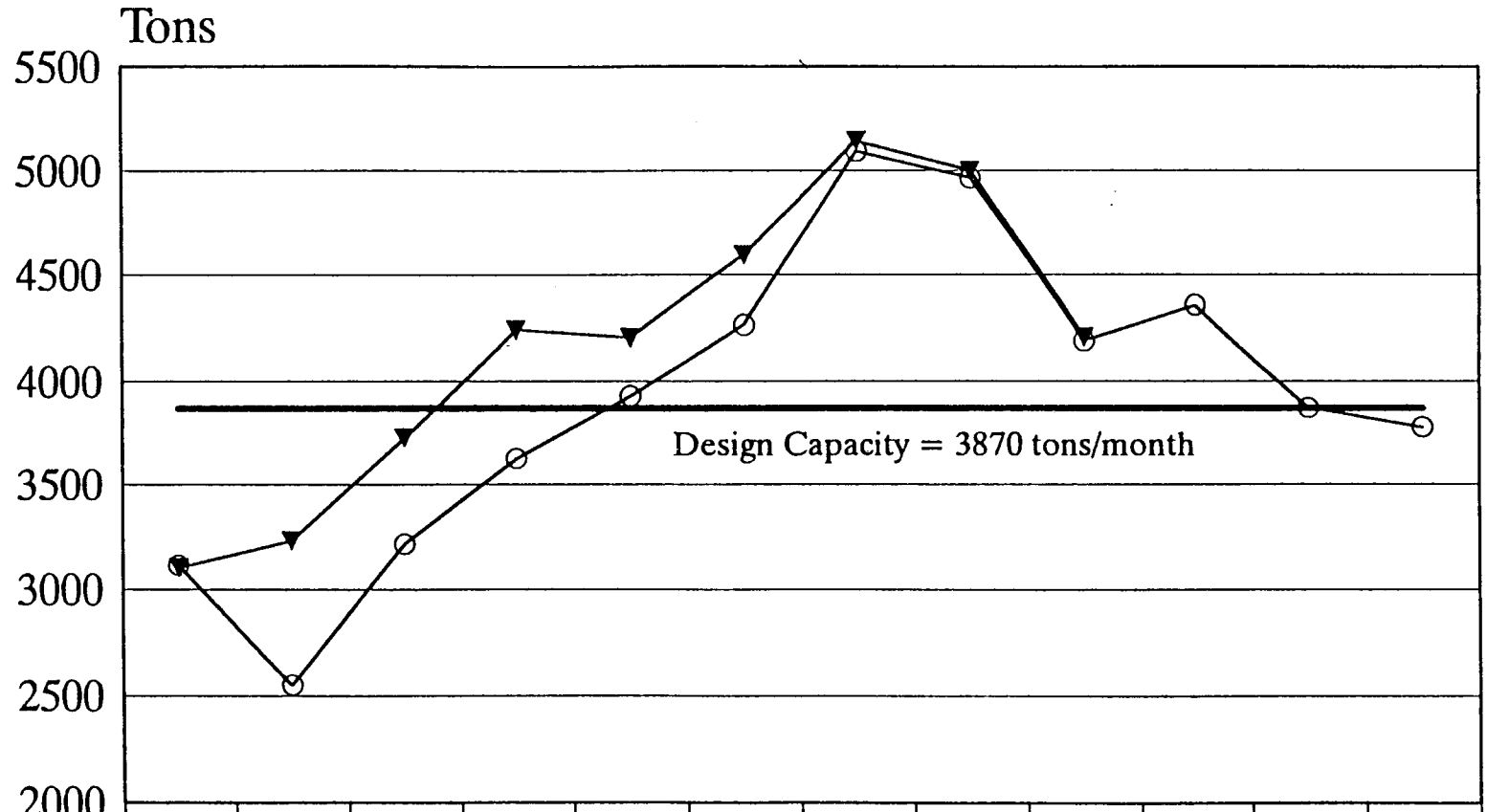
Bedminster is currently in the second year of the compost marketing program in Sevier County, Tennessee. During the first year of this program, compost samples were supplied to prospective customers so that they could verify the benefits of using this compost. As a result of this phase of the program, bulk users, long-term users, and prospects who are the best source of premium revenues for our product have been identified. Bedminster has now established a price of $4.00 per cubic yard and is in the process of converting these users into regular customers.

As new co-composting facilities are developed, Bedminster will include the guarantee that all compost will be used beneficially. This qualifies the process and compost end product as recycling and allows each municipality to meet and exceed the new state mandates on waste diversion and recycling.

TABLE I

Actual MSW Processed vs. Plant Design Capacity

Bedminster Facility - Sevierville, Tennessee

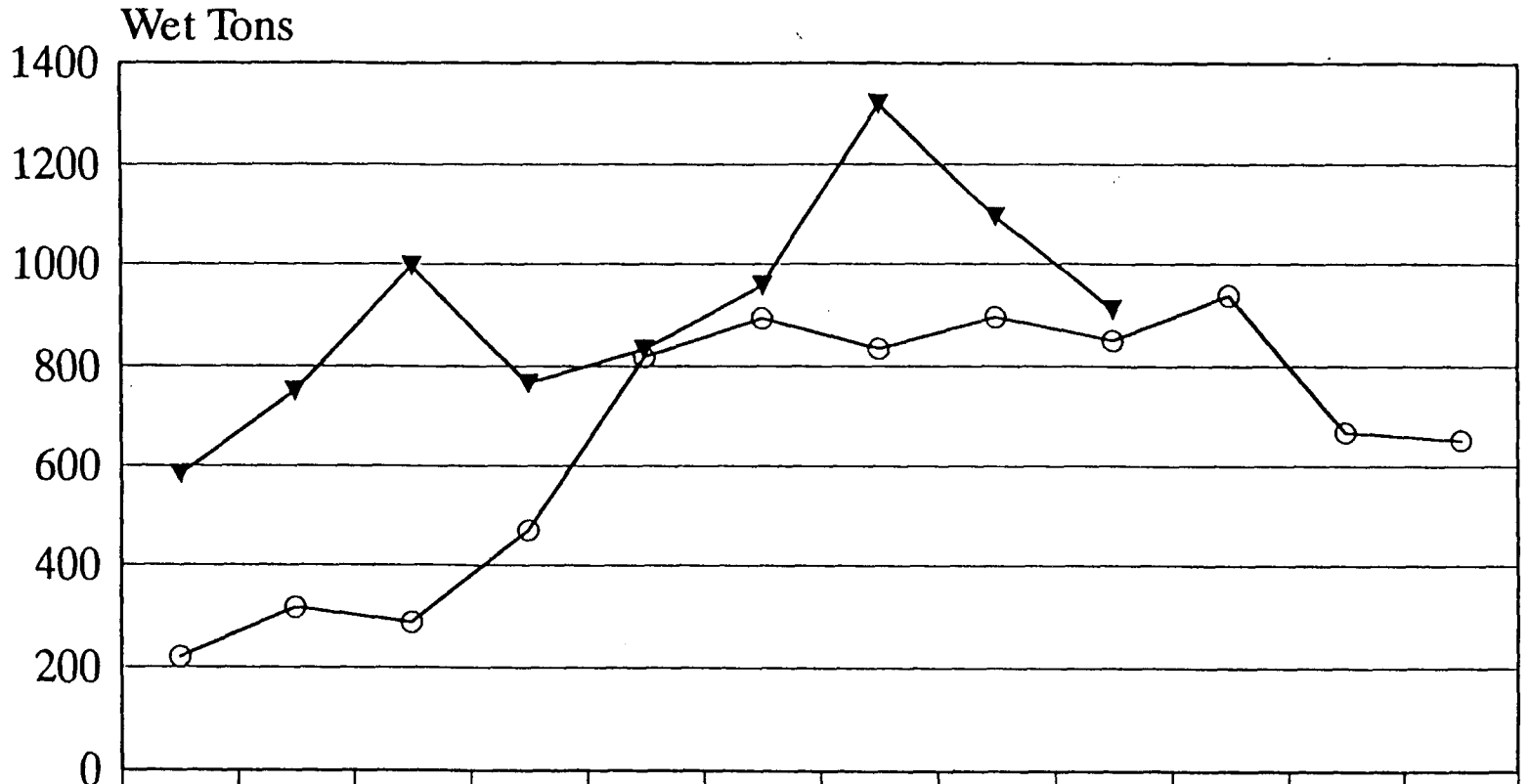


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1993 MSW ↔	3115	2552	3215	3624	3929	4264	5090	4962	4191	4354	3872	3776
1994 MSW ▼	3101	3231	3725	4241	4205	4594	5142	4999	4207			

TABLE II

Actual Biosolids Processed

Bedminster Facility - Sevierville, Tennessee



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1993 MSS ↔	220	316	288	469	818	895	835	897	852	939	668	652
1994 MSS ▼	582	750	996	766	834	958	1319	1092	912			

TABLE III

NUTRIENT ANALYSIS AND PLANT FOOD VALUE OF BEDMINSTER COMPOST

NUTRIENT ELEMENT	FERTILIZER FORM	VALUE (PPM)	REPORTED (PERCENT)	POUNDS PER TON	COMMERCIAL VALUE*	VALUE PER TON
NITROGEN	WIN	0	1.26%	25.15	$18.05	$22.70
PHOSPHORUS	P2O5	0	0.65%	13.06	$3.00	$1.96
POTASSIUM	Potash (K2O)	0	0.47%	9.33	$4.15	$1.94
SULFUR	Elemental	0	0.57%	11.43	$2.25	$1.29
MAGNESIUM	Elemental	0	0.25%	4.95	$6.80	$1.68
CALCIUM	Elemental	0	2.42%	48.43	$0.55	$1.33
IRON	Elemental	10648	1.065%	21.30	$4.00	$4.26
ALUMINUM	Elemental	11948	1.195%	23.90	$13.50	$16.13
MANGANESE	Elemental	285	0.028%	0.57	$6.65	$0.19
COPPER	Elemental	198	0.020%	0.40	$25.35	$0.50
ZINC	Elemental	646	0.065%	1.29	$8.80	$0.57
BORON	Elemental	36	0.004%	0.07	$31.70	$0.11

ORGANIC MATTER	79.5%
pH	7.2
MOISTURE	40.8%

TOTAL PLANT FOOD REPORTED

DRY WEIGHT BASIS = **$52.66**

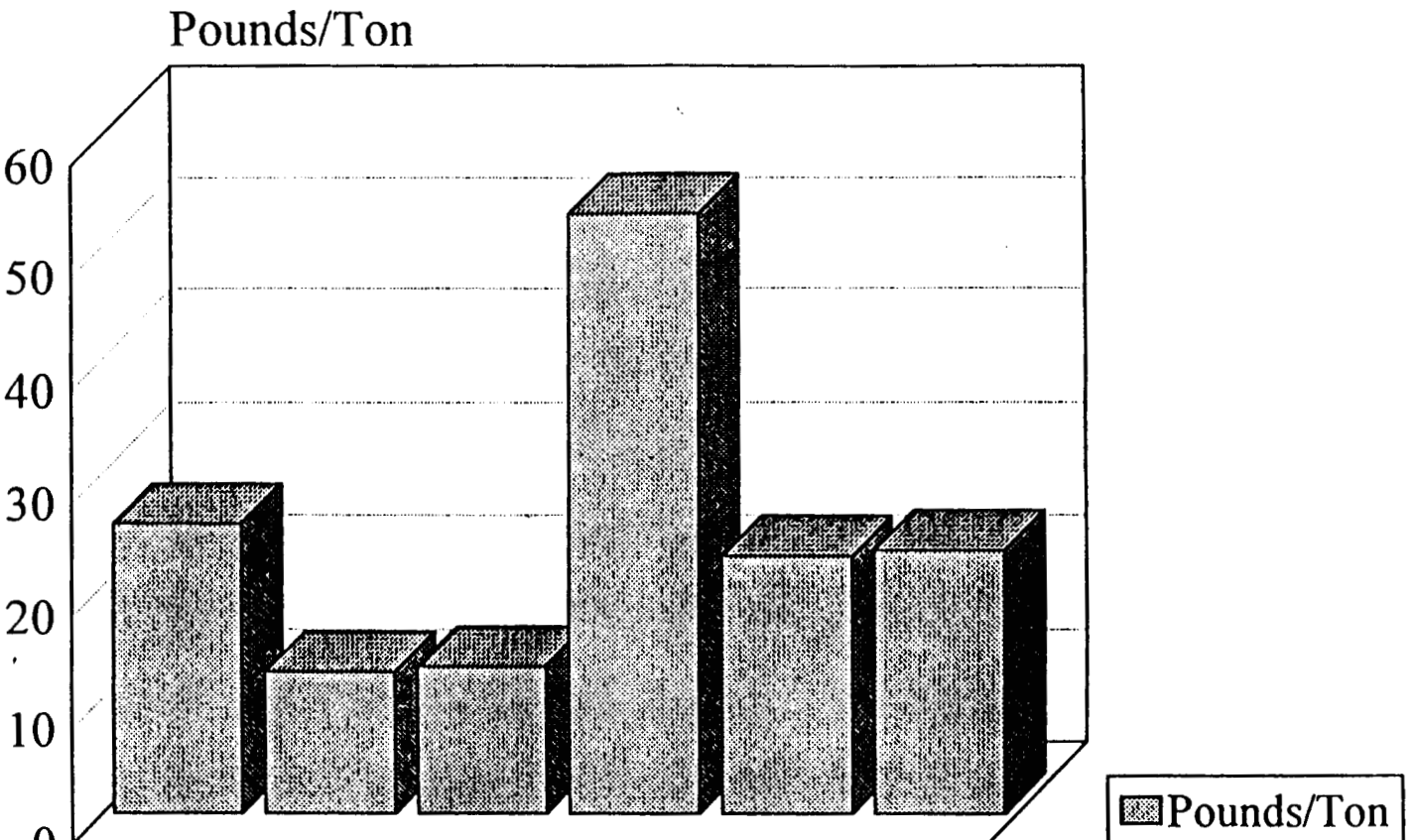
WET WEIGHT BASIS = **$31.20**

NOTE: ALL RESULTS REPORTED ON A DRY WEIGHT BASIS

* Florida Commercial Fertilizer Law, Chapter 576 Florida Statutes

ANALYSIS PERFORMED BY:
A & L ANALYTICAL LABORATORIES, INC.
MEMPHIS, TENNESSEE

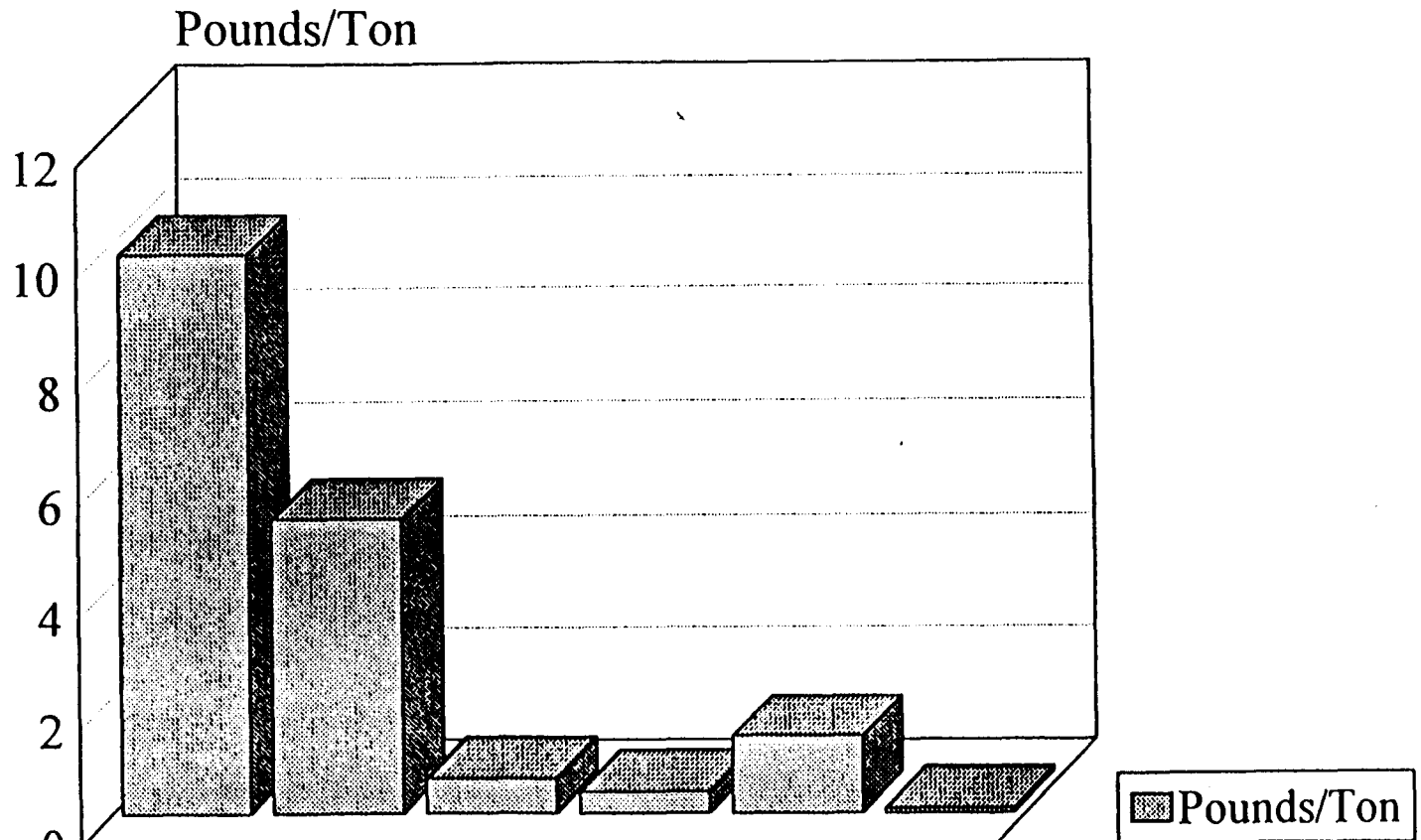
Bedminster Compost* Analysis
Soil Nutrients Per Ton



	Nitrogen	Phosphorus	Sulfur	Calcium	Iron	Aluminum
Pounds/Ton	25.52	12.47	12.92	53.08	22.64	23.15

Note: All results reported on a dry unit basis by A & L Analytical Laboratories, Inc., Memphis, TN
*January to June, 1994 Product Samples From Sevierville, TN Plant

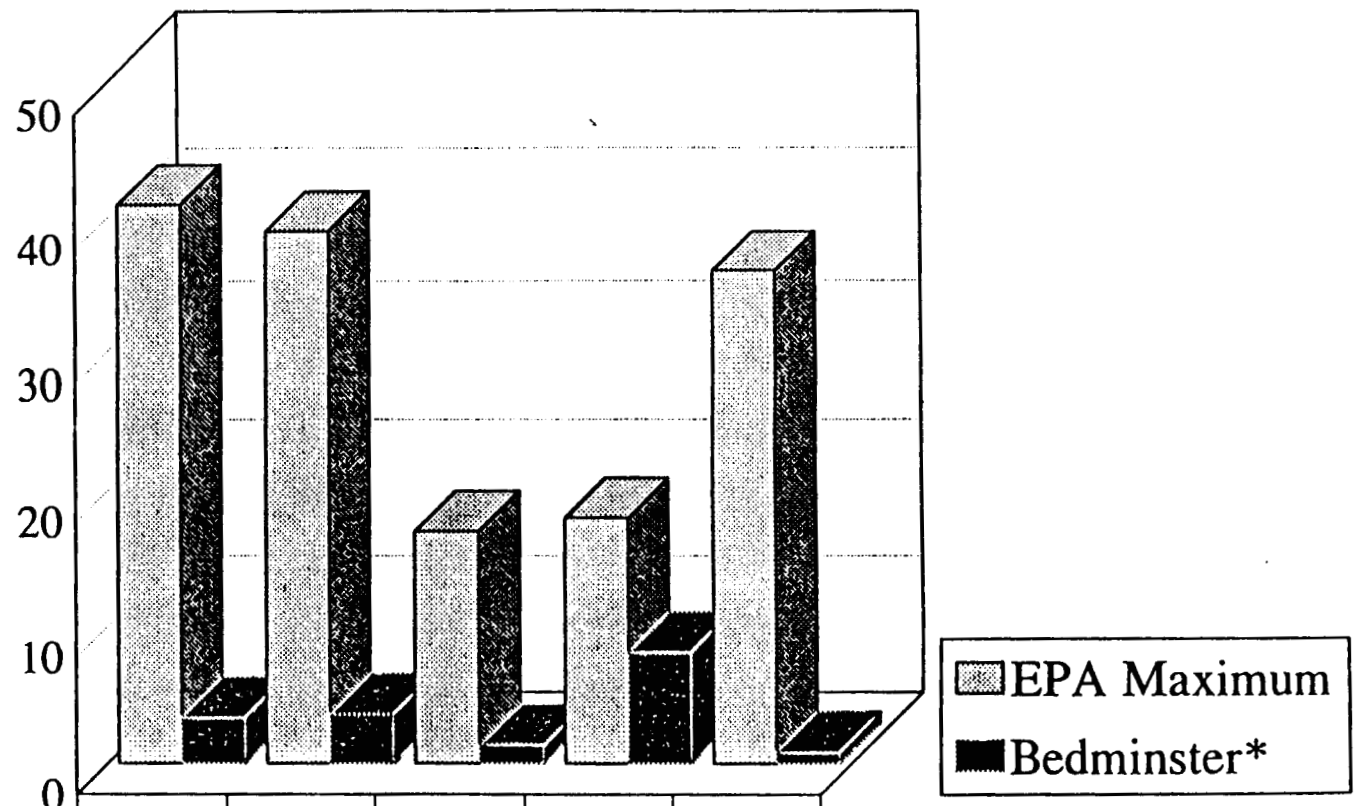
Bedminster Compost* Analysis
Soil Nutrients Per Ton



	Potassium	Magnesium	Manganese	Copper	Zinc	Boron
Pounds/Ton	9.88	5.2	0.59	0.36	1.32	0.08

Note: All results reported on a dry unit basis by A & L Analytical Laboratories, Inc., Memphis, TN
*January to June, 1994 Product Samples From Sevierville, TN Plant

Heavy Metal Analysis: Bedminster vs EPA 503 Maximum Allowable Concentration for "Exceptional Quality" Compost



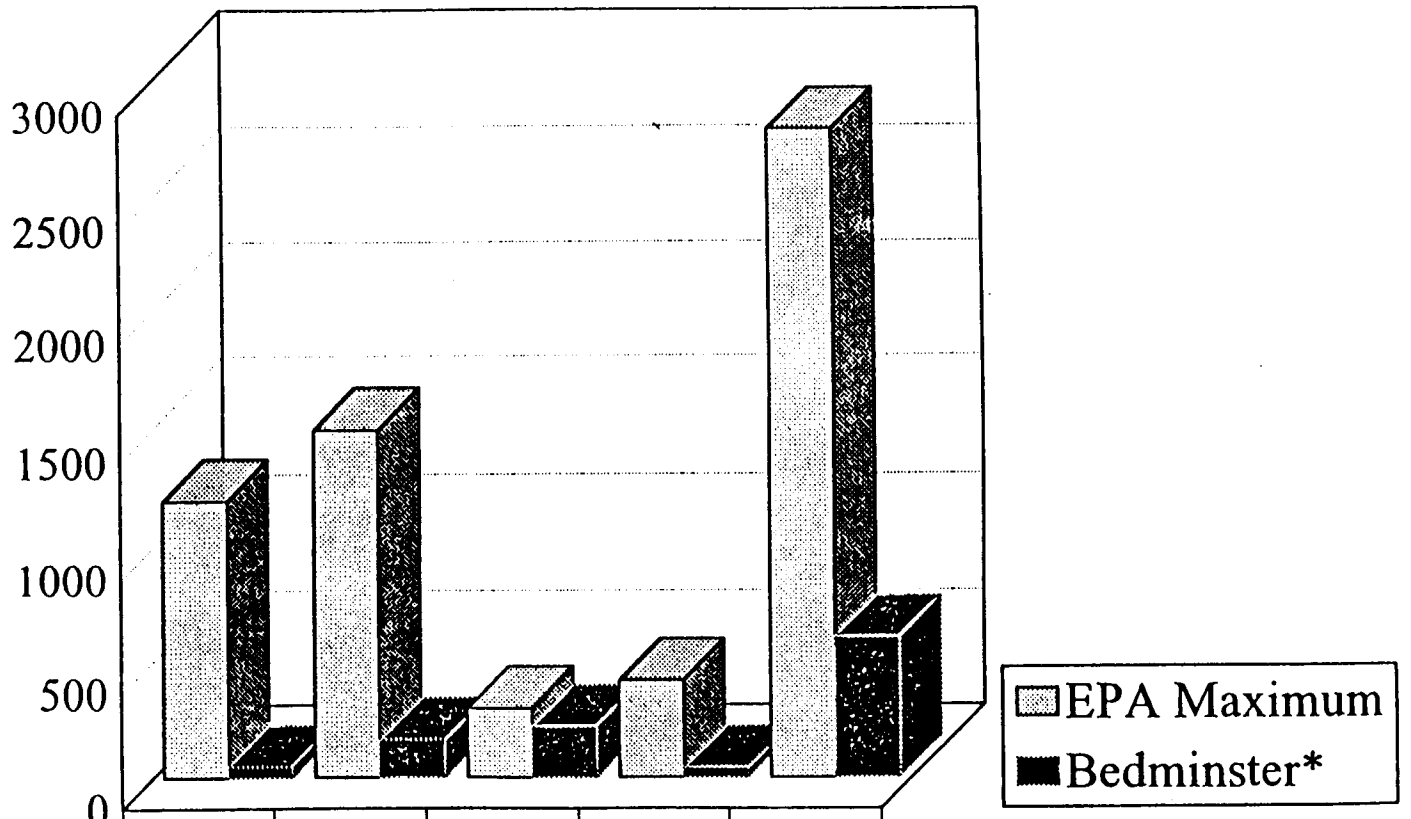
	Arsenic	Cadmium	Mercury	Molybdnm	Selenium
EPA Maximum	41	39	17	18	36
Bedminster*	3.3	3.6	1.4	8.1	0.8

All results reported in mg/kg

*Sevierville, TN Plant

Analysis Performed In August, 1993 By Lancaster Laboratories, Inc., Lancaster, PA

Heavy Metal Analysis: Bedminster vs EPA 503 Maximum Allowable Concentration for 'Exceptional Quality' Compost



	Chromium	Copper	Lead	Nickel	Zinc
EPA Maximum	1200	1500	300	420	2800
Bedminster*	48.2	167	221	43	608

All results reported in mg/kg

*Sevierville, TN Plant

Analysis Performed In August, 1993 By Lancaster Laboratories, Inc., Lancaster, PA