A "*fresh*" look at Manure - "Compost" -
an important "added-value Horticultural Product"
Setting the Standards for Certification

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For many years our agricultural, municipal and industrial organic "left-overs" were considered a waste. Today, the modern farmer calls it **"Manure"** and the modern market gardener calls it **"Organic fertilizer"**. Whatever it is called, it's still some type of manure. Actually, when you look at the material: it is a manure, which comes in various forms: Livestock Manure Compost, Municipal Solid Waste Compost, Mushroom Compost, Biosolids Compost, and Vermiccompost. It is all Organic Material digested in various forms to produce compost. To develop some standards for the product, is a completely different matter.

The European trend in developing Standards and Certification for Compost

If we want to set directions for the Canadian Composting Industry, we must take a serious look at the Europeans, on how they tackle their waste problems. After all they (the Europeans) have been battling surpluses of organic wastes for the past couple of decades. Most importantly, we must take a look at how the Europeans changed organic waste into a valuable agricultural and horticultural commodity. In this paper, I will outline a number of significant quality parameters, which the European used in setting their composting standards.

I have looked at three European countries on how they handled their Organic Waste Diversion and how they were able to produce a "High Value" compost. These three countries, because of their population density (per square kilometer), are presently the European leaders in the production and marketing of quality compost, mainly, through quality control and certification. The three countries, I looked at, are: the Netherlands, Belgium and Italy, with a population density of 351, 323 and 245 inhabitants per $km^{2,}$ respectively.
Their high population density, much higher than Canada, which has a density of 2.6 persons per km^2, necessitated the creation of a task force in Europe during the eighties to design and develop a Waste Diversion System. This system became the foundation of to-days Certification and Marketing System of Composted Agricultural-, Municipal- and Institutional Organic Wastes.

Although the collection of Organic Municipal Waste in Europe is similar to North America. The European focus in Source Separated Municipal Collection, was, and still is today, on the "separate" collection of the organic fraction of residential waste. Although, home composting is being promoted intensively in Europe, Belgian municipalities realized the value of organic residential waste. Every municipality, in Belgium, with a population of 150,000 to 200,000 residents has or is in the process of starting a centralized aerobic or anaerobic (DRANCO) composting system).
The DRANCO (DRy ANaerobic COmposting system is also used by the City of Toronto.

The Belgian Waste Disposal Organization (OVAM) has shown, through regular analysis, that the residents in that country produced 342 kg of residential waste per person per year (ppy) in 1999. Of this 342 kg ppy of residential waste, 37.1 percent (126.8 kg) is organic. Of this 126.8 kg organic waste, 59.1 kg (17.1%) is kitchen waste or Vegetable-, Fruit- and Garden Waste (popularly known as **"VFG-Waste"**) and 49.9 kg (19.6%) is yard waste, popularly known as, **"Green Waste"** and 17.8 kg (5.2%) are yard prunings.
The amount of Green Waste collected, varies by demographics (see table 1).

The Belgians, Dutch and Germans discovered that the value of compost lies in the collected VFG- and GREEN-Waste. Consequently, starting in the late eighties VFG- and GREEN Wastes were collected (by curb-side) separately, in "BIO- and GREEN" containers.
VFG-Waste is composted, in Europe, aerobically and GREEN-Waste, both aerobically and anaerobically. The European countries, actively involved in centralized composting of collected organic household wastes, began developing their own set of quality criteria in the production of compost. The Dutch, however, started developing standards for certification of compost. These standards were adopted by all European countries since they algamated in the European Union. Today, the Germans, Dutch and Belgians, together, developed a common certification process for compost labeling. Although, each country carries its own certification (Quality Assurance) label, the standards used and the certification process followed are similar.

The Compost Quality Parameters used by the Dutch, Belgians and Italians are listed in table 2 These are the parameters determined by each country and set in each country's Fertilizer Act. The main concern, as can be seen in table 2, is the maximum allowable levels of trace elements in compost. Although, the countries agreed on the levels stated in table 2, the Dutch were setting stricter limits. The Dutch are now marketing Certified Standard Compost, which they term "clean" compost, when the levels are in-line with their European counter parts. However, the Dutch also produced compost at much stricter standards, with respect to the heavy metal content. This Compost is marketed as Certified "High Quality" Compost, which the Dutch term "extra clean" compost. The difference between clean and extra clean compost can be seen at the differences of allowable maximum levels of Cadmium, Chromium, Copper and Mercury in the compost (table 2).

In getting an edge in the market place, the Europeans are determined to bring the levels of heavy metals even further down. They realized that the quality of the compost produced lies within two areas: 1) the "separate collection of VFG-Waste and GREEN-Waste and 2) the Aerobic Composting Process. To-days, the home maker is becoming careful with the quality of organic material that moves through the kitchen pantry. Consequently, the kitchen's waste output, at the curb-side, in Europe, is much cleaner today as it was a number of years ago. Municipalities, in turn, are urging residents to separate their output of "organic" residential wastes three-ways: VFG-, GREEN- and GRAY Waste. The GRAY waste is a collection of disposable diapers, coffee filters, coffee grounds, tea bags, vacuum dust, disposable milk cartons, etc. GRAY waste is destined to be composted by anaerobic composting only. Most municipalities are, presently involved, or will be, in promoting a three-way separate collection of organic residential waste.

To determine where we (in Canada) stand at the present time in our evolution in composting and labeling of compost for certification, let me ask you the following questions based on compost analyses featured in the tables below:

Where does the Canadian Standards stand for Composting at the present time with respect to concentration of trace elements of heavy metals?

A comparison of allowable maximum levels of trace elements of heavy metals for the Netherlands, Belgium and Canada is listed in table 3. The Canadian Standards for compost at the present time, are reflected in three categories, nl: AA, A and B. The AA and A types (set by the BNQ (Bureau de Normalisation du Quebec) have similar allowable levels of trace elements of heavy metals. However, if the Canadian Waste Diversion Organizations were to separate their organic collected wastes into VFG- and GREEN wastes, a BNQ category of AA compost could be created, which would have allowable maximum levels of trace elements, similarly to the Dutch', "clean" or "very clean" compost or the Belgian "Standard Compost".
As can be seen from table 3, BNQ's Category "B" allows a much higher level of these elements. In order for certification of Canadian produced compost to take place, a compost with lower levels of these trace elements must be produced. To achieve this type of clean or very clean compost, more emphasis on the separation and collection of organic residential waste, at its source, must be given. In order to collect "cleaner" residential waste, an expanded and emphasized public education campaign is required. An example of on-line consumer education is found in Appendix A.

How does regular collected Organic MSW differ in compost characteristics from VFG or GREEN Waste?

A comparative study was done in Reggio Emilia, Italy in 1997, where GREEN Waste was composted separately from regular MSW Waste. These compost data, along with VFG-Compost data (from an aerobic composting process in Wijster, the Netherlands, are presented in table 4. For comparative purpose, the European accepted quality standards are listed in the left column. The physical and nutritional characteristics of the Italian compost (in table 4) are well within the accepted European standards. Looking at the table of allowable maximum levels of heavy metals, it can be seen that the compost produced from GREEN waste was of much better quality than the compost produced from regular MSW waste, except for the copper which was present, in both composts, in high levels. Within the BNQ standards, the regular MSW compost from Reggio Emilia would classify as a Category B compost, suitable for agricultural application only. If a further source separated collection of this Italian MSW waste was done, then its compost could be upgraded to an A or AA Category, in Canadian standards, and subsequently marketed for a higher price after certification.

Is the NO_3-N / NH_4-N Ratio a good indicator for quality compost?

The Europeans say that quality finished and cured compost should be high in Nitrate-N (NO_3-N) and low in Ammonium-N (NH_4-N), comparatively (table 2).
The NO_3-N / NH_4-N Ratio for the Italian Reggio Emilia: GREEN Compost, regular MSW Compost (table 4) and the Flemish VFG-Compost, "Humotex", and GREEN Compost (table 5) are: 2.11, 0.83 (table 4) and 0.04, 0.06, 0.52 (table 5) respectively.
These ratios indicate that compost made from GREEN Waste makes a higher value compost. Since the majority of compost produced enters the Horticultural Market as a substitute to peat moss, a comparative study of all its comparative physical and chemical characteristics to peat moss is warranted. Horticultural Peat moss, for example, has a NO_3-N / NH_4-N Ratio of 0.71 (Can. J. Soil Sc. Vol.: 77 (3), 1997).

How does the C/N Ratio effect the quality of compost?

The Carbon to Nitrogen-Ratio (C/N-Ratio) is a good indicator of "how well the compost is finished and cured. The European Standards indicate that the ratio should be below 18.0- 1. Again, looking at the Italian Reggio Emilia composts in table 4 and the Belgian composts in table 5, it can be seen that all composts, except the Italian Regular MSW, have a C:N Ratio well below 18 - 1. The Canadian Standard have a maximum C:N Ratio of 25:1 as the norm. Keeping in mind that most soils have a C:N Ratio of 11 : 1 and an Organic Matter to Nitrogen of 20:1. An application of compost with a C:N Ratio of higher than 20 : 1 will have a Nitrogen depletion effect on the soil, resulting in poor plant stand. Looking at table 5, the Belgian composts, for example, The VFG-Compost, Humotex-compost and the GREEN Compost have a C:N Ratio of: 10.7 - 1, 14.1-1 and 15.0-1, respectively and a Organic Matter (OM), dry : Nitrogen (N-tot), dry, Ratio of: 19.6, 27.1, and 26.9 : 1, respectively. If these three composts recorded a C:N Ratio of more than 20 : 1, a definite deficience of soil-nitrogen would be created.
Horticultural Peat Moss, for example, has a C:N Ratio of 28:1. With its High OM and low Nitrogen content, peat moss, when applied in large quantities, has the habit to create large Nitrogen deficiencies. Peat moss is usually, as a growing substrate, blended with perlite and vermiculite in a ratio of 1 : 1 : 1 (v,v,v). Quality compost should, therefore, have a C:N Ratio of less than 18: 1 and an OM, dry : Total N, dry Ratio of 17 - 20 : 1.

Does particle size contribute to quality of compost?

Particle size is probably the most important characteristic of quality compost to the home gardener. "Compost must be seen when applied to the garden" is the common comment, often heard. To he professional horticulturist, however, particle size of compost is important relative to the compost usage. Compost should be offered for sale in the following particle sizes:

1. **Compost for mulching** should be offered for sale in a particle size of 50 - 75 mm.

100 percent should pass through a 75 mm screen and less than 70 % through a 50 mm screen. The compost should be "actively" finished, but only partly cured.

2. **Compost applied as a soil amendment** should be offered for sale in a particle size of 10 -25 mm. 100 percent should pass through a 25 mm screen and less than 70 % through a 10 mm screen. The compost should be "actively" finished and well cured. Both aerobically and anaerobically produced compost are ideal as a soil amendment material for the home garden, as long as the C:N Ratio is well below 20 : 1. The allowable levels of trace elements of heavy metals should be close to the Dutch category: "Clean" or Very Clean", depending on the type of garden vegetables grown.

3. **Compost applied as a substrate in a growing blend for a potting medium** should be offered sale in a particle size of 6 - 15 mm. The compost should be finished and fully cured (> 9 months). The C:N Ratio should be well below 18 : 1.

4. **Compost applied as a seeding substrate (top dressing, hydro seeding, seeding of annuals, rooting of cuttings, snow making etc.)** should be offered for sale at a particle size of < 6 mm. The compost should be produced by aerobic composting process and be fully cured for more than 12 to 18 months. The C:N Ratio should be well below 18 : 1.

What should be the "soluble salt" levels in compost?

The soluble salt levels are measured by electrical conductivity (EC), most commonly in mmhos/cm. The maximum EC levels are very critical in the usage of compost for plant growth. EC values should not exceed the values of 4.0 mmhos/cm in mulches, 1.5 in soil amendments, 1.5 in growing substrates and 0.75 mmhos/cm in seeding substrates. If the levels of EC Values are higher than these values a proper blend must be found to correct the values to acceptable levels.

What should the Organic Matter content be in Compost?

The Dutch Fertilizer and Organic Fertilizer Act: "Besluit en gebruik Overige Meststoffen (BOOM), 1992, states: The Organic Matter content of all types of compost must be at least 20% of the Dry Matter Content. Is the percentage Organic Matter of the product smaller than 20%, than the product has similar norms as Black Soil and is not to be sold as compost.

What are the procedures to follow when certifying Canadian Produced Compost?

Looking at Europe, each country has its own certification procedure. Belgium follows a 2-phase process, nl: A Recognition Phase and a Start-up Phase. The UK is still working on its certification procedure, but is following the Belgian Procedure. Belgium certifies its compost producers as follows:

Certification Procedure practiced in Belgium

1. <u>Recognition</u> <u>Phase</u>

The duration of this application in order to receive recognition is a minimum of 1 year.
The inspection, analysis and the validity standards are provided by the Belgian Ministry of Agriculture. The ministry conducts a minimum number of analyses, based on the production capacity, which is as follows:

4,000 - 20,000 tons supply / year: 8 analyses
> 20,000 tons supply / year: 12 analyses

The Ministry of Agriculture will also conduct a full composting process supervision and a maintenance check of the compost diary.

Once the producer has passed the initial Recognition Phase, the second phase of the application for certification, called the Start-up Phase.

2. <u>Start-up</u> <u>Phase</u>

The validation of this phase is conducted by an independent Certification Organization. In Belgium this examination is conducted by VALCO. The duration of this phase will last for a minimum of 1 year. The standards applied in certifying the product are the standards listed in table 2 and 3, which are the current VLACO standards.
The number of analyses conducted are similar to the number used in the Recognition Phase, based on the producers's production capacity:

4,000 - 20,000 tons supply / year: 8
> 20,000 tons supply / year: 12

VALCO conducts a full process supervision evaluation and full maintenance check of the compost diary. If the producer passes the second year's evaluation, the product will qualify for certification.

The quality label (certification label) is provided when the product meets the quality criteria listed in table 2 and 3 and, in the case of the Dutch producers, can apply for "clean" compost or "very clean" compost if the concentration of trace elements of heavy metals (VFG-Compost or Bio-Compost and Green Compost) fall within the criteria listed in the two left columns in table 3.

What ever the designation or certification of the compost will be, we must remember that compost remains primarily a **soil improvement** material whose effectiveness is mainly dependent on the high content of organic matter. A minimum content of 20 % Organic Matter of the DM content is a required standard.

The average compositions of three compost analyses are shown in table 4

Concerning the trace elements of heavy metals, all three analyses showed that the concentrations are well within the set standards for The Netherlands and Belgium. Composts made from VFG-Waste and Green Waste will in general produce a higher quality compost than compost made from mixed MSW Waste. The NO_3-N/NH_4-N Ratio is a good indication of the maturity of the compost. Composts made from VFG-Waste has more difficulty in reaching the maturity standards set for maturation than composts made from Green-Waste.

Currently, negotiations are under way across Europe to adjust standards for compost maturation to bring them more in line with the current applications and utilization potential.

Improving the Quality of Compost

Quality Compost can only be produced if the whole waste cycle is carefully monitored, controlled and adjusted where necessary. Changes in the composition of the raw feedstock, when collected, the composition during the composting process, and the composting process itself must be carefully monitored. The composting industry is in constant change.
The source of the quality of compost lies within the source of the Organic Fraction of the MSW itself. Municipalities are required to deliver quality organic waste to the composting facility. The Municipalities, in turn, are to educate the residents, where the waste is collected in the first place, on the importance of sub-separating organic household wastes into: Green Kitchen Wastes (VFG-Waste), Gray Waste, and Green Yard Waste (Green Waste). An example of how Municipalities can educate their citizens, on-line, in separating residential wastes: a 2-page "information-bulletin" is shown in Appendix A. This type of bulleting can be up-dated and include seasonal composting information. These bulletins are <u>only</u> bulletins and should be brief and to the point. Diverting Residential Organic Wastes into three streams: VFG-, Gray and Green Waste, a better quality control can be exercised at the composting facility. It is important to realize that VFG- and GREEN- Wastes have a very high commodity value as compost to the Horticultural Industry. These composts can be marketed as substrates for seeding- and potting mixes, for hydro-seeding and even for snow making on ski hills.

"These are the products that qualify for certification".

Table 1

Total Supply of collected Residential Waste in Belgium in 1999

Total Supply of Residential Waste in kg per person per year	549
Percent change over 1998	+3.34%
Percent change over 1991	+35.6%
Total Supply of Selectively Collected Residential Waste in kg per person per year	342
Belgian Waste Diversion (in percentage)	62.3 %
Percent change over 1998	+ 10.3%
Percent change over 1991	+362.%

Supply of <u>selectively</u> collected residential waste in 1999

	in person / yr kg	%	
Total Supply of **selectively** collected residential waste	342	100	
Break-down			
Construction and demolition waste	75.5	22.1	
Paper and Carton	65.8	19.2	
VFG-Waste	**59.1**	**17.3**	
percent change over 1998			+ 4.8%
GREEN-Waste	**49.1**	**14.4**	
Yard Prunings	**17.8**	**5.2**	
Total GREEN-Waste and Yard Prunings	**66.9**	**19.6**	
percent change over 1998			+ 3.4%
Rural, agricultural	**50 - 80 kg**		
Rural, non-agricultural	**40 - 55 kg**		
Urban	**20 - 30 kg**		
Wood waste	14.5	4.2	
Metal	11.6	3.4	
Synthetics	5.4	1.6	

Beverage cartons	1.1	0.3
Remainder	42.1	12.3

Source: OVAM, Belgium, Huishoudelijke afvalstoffen: Inventarisatie 1999

Table 2

COMPOST QUALITY PARAMETERS FOR QUALITY COMPOST

A **PHYSICAL**

Particle size (mm)	1 - 15 mm (0.04 - 0.6 inches)
Oversized particles (%)	<5 % > 40 mm (>1.6")
Stones (> 5mm) in DM (%)	< 3.0
Impurities (>2mm) in DM (%)	< 0.5
Bulk density (kg/m^3)	600 kg / m^3 (1012 lbs./yd^3 or 37.5 lbs/ ft^3)
pH	6.5 - 8.5
EC (mS/cm)	< 5.5 mS/cm or <5,500 microS/cm (preferable 1.5 - 3.0 mS/cm) (<= 1.6 mS/cm for green compost, <= 3.0 mS/cm for VFG compost)
Organic Matter (OM), of DM (%)	> 20
Dry Matter (DM) (%)	> 60
Moisture content (%)	<=40
Moisture retention (%)	=>60
Micro-organisms	10^6 - 10^9/ gm
End temperature	20 - 25^0 C

B **NUTRIENT CONTENT** (Organically bound)

Total N (%)		=> 0.7
Total NH_4-N	(ppm)	low
Total NO_3-N	(ppm)	high
C/N Ratio		< 18
Total P_2O_5	(%)	=> 0.5
Total K_2O	(%)	=> 0.75
Total MgO	(%)	=> 0.35
Total CaO	(%)	=> 2.0
Total Cl (%)		< 0.5

C **MAXIMUM CONCENTRATION OF TRACE ELEMENTS (HEAVY METALS) IN MG/KG DM**

Element	**Symbol**	**ppm (mg/kg)**	
Arsenic	(As)	15	
Cadmium	(Cd)	1.5	(1.0 in the Netherlands)

Chromium	(Cr)	70	(50 in the Netherlands)
Copper	(Cu)	90	(60 in the Netherlands)
Mercury	(Mg)	1	(0.3 in the Netherlands)
Nickel	(Ni)	20	
Lead	(Pb)	120	
Zinc	(Zn)	300	

D **LIMITS OF HUMAN PATHOGENS**

Salmonella	Absent
Escherichia coli 0157:H7	Absent

Table 3

Comparison of allowable maximum levels of trace elements in quality compost in mg/kg of 20% DM)

	The Netherlands [1,2)]		**Belgium** [3)]	**Canada** [4)]		**UK** [5)]
	Very Clean Compost	Clean Compost	Standard Compost	BNQ AA / A (type)	BNQ / CCME B (type)	TCA (proposal)
As	5	15	15	13	75	-----
Cd	0.7	1	1.5	3	20	1.5
Cr	50	50	70	210	1,060	100
Cu	25	60	90	100	757	100
Hg	0.2	0.3	1	0.8	5	1
Ni	10	20	20	62	180	50
Pb	65	100	120	150	500	150
Zn	75	200	300	500	1,850	400

Source: 1) Besluit en gebruik Overige Organische Meststoffen (BOOM), 1992, The Netherlands
2) Kompost und Kompostqualitat in den Niederlanden, Brethouwer, T.D.,, J. van Thubergen, 1994, nv. VAM, Hilversum, The Netherlands
3) Integrated Quality Control Basics for Compost Sales, Vande Ryse, G, VLACO vzw, Mechelen, Belgium
4) Setting the Standard: A Summary of Compost Standards in Canada, 2000, The Composting Council of Canada
5) UK, The Composting Association (TCA): A Feasability Study of the Introduction of Process and Quality Standards for Compost in the UK (proposals)

Table 4

A COMPARISON OF COMPOST QUALITY PARAMETERS FOR QUALITY COMPOST (VFG-COMPOST, The NETHERLANDS AND MSW, GREEN COMPOST IN ITALY

			VFG-Waste VAM, Wijster Holland	**Reggio Emilia Italy**		
			Regular Compost	**Green Compost**	**Regular (MSW) Compost**	
A	**PHYSICAL**					
		Quality Standards				
	Particle size (mm)	1 - 15 mm	10	10		10
	Oversized particles (%)	<5 % > 40 mm	0	–	---	
	Stones (> 5 mm) in DM (%)	< 3.0	1.07	–	---	
	Impurities (> 2mm) in DM (%)	< 0.5	0.15	–	---	
	Bulk density (kg/m^3)	600 kg / m^3	-----	----	----	
	pH	6.5 - 8.5	8.1	6.8	7.2	
	EC (mS/cm)	< 5.5 mS/cm	2.9	1.18	3.32	
	Organic Matter (OM), of DM (%)	> 20	28	27.5	25.8	
	Dry Matter (DM) (%)	> 60	65	62.2	62.2	
	Moisture content (%)	<=40	—	—	----	
	Moisture retention (%)	=>60	—	—	----	
	Micro-organisms	10^6 - 10^9/ gm	—	—	----	
	End temperature	20 - 25^0 C	27	—	----	
B	**NUTRIENT CONTENT** (Organically bound)					
	Total N (%)	=> 0.7	1.38	1.5		1.2
	Total NH_3-N (ppm)		-----	75	218	
	Total NO_3-N (ppm)		-----	158	180	

C/N Ratio		< 18	-----	18.3	21.5
Total P_2O_5	(%)	=> 0.5	0.61	0.85	0.81
Total K_2O	(%)	=> 0.75	0.93	0.60	0.58
Total MgO	(%)	=> 0.35	0.41	—	----
Total CaO	(%)	=> 2.0	2.47	3.8	6.1
Total Cl	(%)	< 0.5	0.32	—	-----

C MAXIMUM CONCENTRATION OF TRACE ELEMENTS (HEAVY METALS) IN MG/KG DM

Arsenic	(As)	15	3.2	ND*	ND
Cadmium	(Cd)	1.5	0.83	ND	3.2
Chromium	(Cr)	70	18	45.18	154.3
Copper	(Cu)	90	34	186.5	690.4
Mercury	(Hg)	1	0.12	ND	2.3
Nickel	(Ni)	20	9.7	29.39	253.3
Lead	(Pb)	120	----	98.45	532.4
Zinc	(Zn)	300	158	274.9	987.4

ND* = Not Detected

Table 5
Composition of VFG-Compost, Humotex and Green-Compost (medium values based on final analyses)

Parameter	**VFG-Compost**	**Humotex***	**"Green"-Compost**	**Final analysis Unit**
DRY MATTER (DM) AND MOISTURE CONTENT				
DM	67.2	58.0	60.0	weight %
Moisture	32.8	42.0	40.0	weight %
CONTENT OF ORGANIC MATTER (OM) OF FRESH WEIGHT (Org. Matter, fresh) AND OF DRY WEIGHT (Org. Matter, dry)				
OM, fresh	23.7	22.3	20.3	weight %
OM, dry	35.4	38.2	34.9	weight %
SOLUBLE SALT CONTENT (=CONDUCTIVITY, EC), ACIDITY (=pH) AT 1/5 DILUTION AND CHLORIDES				
EC (1/5)	2.6	1.25	1.07	mS/cm
pH (water)	8.5	8.0	8.1	-
Chlorides	1424	560	734	ppm (mg/l)
TOTAL NITROGEN CONTENT AT FRESH WEIGHT (N-Tot, fresh) AND AT DRY WEIGHT (N-Tot, dry)				
N-Tot, fresh	1.20	0.76	0.78	weight %
N-Tot, dry	1.86	1.41	1.30	weight %
AMMONIUM-N (NH_3-N) AND NITRATE-N (NO_3-N) AND NITRATE-AMMONIUM RATIO (NO_3-N/NH_3-N)				
NH_3-N	396	201	48	ppm (mg/l)
NO_3-N	16	12	25	ppm (mg/l)
NO_3-N/NH_3-N	0.04	0.06	0.52	
CARBON-NITROGEN RATIO (C/N)				
C/N	10.7	14.1	15.0	
TOTAL CONTENT OF NUTRIENT ELEMENTS (P_2O_5, K_2O, Ca and Mg)				

Total P_2O_5	0.59	0.50	0.30	weight %
Total K_2O	0.86	0.37	0.45	weight %
Total MgO	0.31	0.26	0.25	weight %
Total CaO	2.00	1.97	1.43	weight %
CONTENT OF HEAVY METALS				
Cadmium (Cd)	0.71	1.00	0.85	ppm
Chromium (Cr)	17.0	19.0	15.0	ppm
Copper (Cu)	44.0	31.0	33.0	ppm
Mercury (Mg)	0.13	0.15	0.14	ppm
Lead (Pd)	70.0	98.0	58.0	ppm
Nickel (Ni)	12.0	11.0	7.9	ppm
Zinc (Zn)	238.0	187.0	180.0	ppm
IMPURITIES, VIABLE SEEDS AND PHYTOTOXICITY				
impurities > 2mm	0.09	0.19	0.07	weight %
small stones > 5mm	0.47	0.69	0.71	weight %
viable seeds	0.0	0.0	0.0	no./l
phytotoxicity	>10.0	8.0	4.0	%

Source: VLACO- Flemish Organization for the Quality Control and the Certification of bio- and green compost before sale. 1999. **Humotex*** is anaerobic MSW-compost, produced by the "DRANCO"-fermentation Process.

Table 6

SAMPLE OF COMPOST ANALYSIS

of Ontario produced Compost

Certificate of Analysis

Client:
Attention:
Project: **Report#:**
Phone: **Sample Matrix:**
FAX: **Date of Report:**
Invoice #:

Method:

PARAMETERS	**SAMPLE ID/RESULTS**		**CERT. STANDARDS**
	food waste (bulk)	**mushroom bagged**	
Total Nitrogen	2.55	2.33	=>0.7
Total Phosphorus	0.72	0.90	=>0.5
Total Potassium	1.80	2.35	=>0.75
Magnesium	0.75	0.84	=>0.35
Calcium	10.8	12.6	2.0-3.0
Sodium	0.48	0.29	
Manganese	260.0	310.0	
Sulfur	25,000	30,500	
Boron	25.5	27.5	

Copper	44.5	29.5	< 90
Iron	5,400	2,900	
Zinc	170.0	210.0	<300
Aluminum	2,575	1,500	
Total Organic Matter	51.9	52.8	>55
Total Ash	48.1	47.3	
Total Organic Carbon	28.8	29.3	>20
C/N Ratio	11.3	12.6	<18
Conductivity	26.0	17.6	<5.5
pH	7.28	7.39	6.5 - 8.5
Moisture	48.9	49.9	<=40

Results Authorized By: _____

Laboratory Director

Notes: Results Reported On Dry Weight Basis

APPENDIX A

An Example of an "on-line" Municipal Bulletin with Information on Composting
These bulletins can be up-dated and inserted in regular municipal citizen information

BULLETIN

Compost

Composting is a process that transforms all kinds of organic waste by the action of bacteria, fungi and other soil-borne organisms into a humus-rich garden soil. Within just a couple of months organic waste changes into a very valuable garden product.

Environmental-information

Compost is a soil amendment material

Compost is good for the garden as a soil amending material. Compost improves the structure of the soil, allows more drainage of excess water. Moisture is retained much better during dry periods and less irrigation is needed. Above all, compost activates "life' in the soil. Earthworms, insects and many other little soil-critters become more active. Compost transforms the soil into a "living organism". Plants growing in a compost-enriched soil, are better able to absorb nutrients.

Compost , when it breaks down, after it is worked into the soil, is able to fight off soil-borne plant diseases, that cause plants to wilt and die.
Compost is produced from **V**egetable-, **F**ruit- and **G**arden **Waste** (**VFG-Waste**), but also from yard prunings and fallen leaves (**GREEN-Waste)**. Compost is a good substitute for peat moss, which is a non-renewable organic raw material.

VFG-Waste as VFG-Compost
Over 90% of the residents have access to separate collection of VFG-Waste and GREEN-Waste. VFG-Waste, along with GREEN-Waste is used primarily to produce quality garden compost. In 1997, enough quality compost was produced to cover 90,000 football fields. This is good for the environment! The organic waste disappears, not into landfill sites or in incinerators, but into the garden! Because VFG-Waste and GREEN-Waste is composted, separately, other biological disposable wastes can be better transformed into more efficient energy.

Impurities
Compost may contain impurities, such as trace elements of heavy metals. By composting VFG-Waste and GREEN-Waste, separately from any other compostable waste, a better and healthier compost can be produced with very minute concentrations of trace elements of heavy metals. These compost are identified as “Clean-Compost” and “Very clean-Compost”.

Practical information - make your own compost

Make your own compost. It saves money in organic waste collection, transport, centralized composting and bagging. Most garden centres sell home-composters. Below is a list of VFG-Waste and GREEN-Waste that can and cannot be added to a back-yard compost pile

YES	NO	QUESTIONABLE
fruit peels	bread	potato peels
vegetable waste	cheese	citrus peels
fruit waste	charcoal	saw dust
egg shell	cigaret ashes and butts	wood ashes
peat moss	bread	discarded house plants
potting soil	vacuum bags and - dust	discarded cut flowers
tea bags and -leaves	excrements from pets	weeds
tea leaves	wool, cotton and textiles	straw
lawn clippings	paper (even shredded)	wood chips
tree leaves	cooked dinners	
small yard prunings	fish- and chicken bones	

coniferous needles twigs and branches
garden soil

Clarification on the questionable list

✶ Potato peels, citrus peels, house plants and cut flowers may contain residues of pesticides and therefore they should not be used in a back-yard compost pile. The residues they contain may slow down the composting process of VFG-Waste.

✶ Wood ashes, straw, saw dust and wood chips are very dry. They can be added to the compost pile, only, in small quantities and should be thoroughly mixed with other greener VFG- and GREEN-Waste.

In general, make the composition of the compost pile as variable as possible. Mix moist with dry material, soft with hard, carbon-rich (the Browns), such as saw-dust, straw and leaves, with nitrogen rich (the Greens), such as grass clippings, manure and garden waste.

Since the garden waste is removed from the garden in a short period of time, the organic VFG-Waste should be added to the compost pile in stages over time.

Garden Tips

➜ Spread VFG-Compost over the entire garden, in a layer of about 1.5 cm thickness. You apply about 10 kg of compost per m^2 (20 pounds per 10 square feet) of garden area. Apply the compost in April or May (on a heavy clay soil, the compost should be applied in the Fall).

➜ Too much compost on the garden is not good! A high concentration of compost around the plant roots can cause burning of the roots of vegetables and flowering annuals.

➜ A dry sandy soil can be much better cultivated and will hold moisture much better after it has been enriched with VFG-Compost.
A "slippery" clay soil, enriched with compost, can be worked much better as well, but will also drain better after rain fall and will provide much better aeration with an application of compost.

➜ Compost mixed with garden soil (mixed one part of compost to 3 parts of garden soil) makes an excellent potting soil for large house plants.

➜ Compost Tea is very nutritious for any garden plant. Fill one-half of a watering can with compost, add water until the can is full. Mix the compost and water by stirring thoroughly until the entire content is a homogeneous mixture. Let the mixture stand for a few days until the solids have settled at the bottom of the can. Pour the compost-water (compost tea) around the plants. Compost tea is very useful to strengthen garden plants and to activate their growth, especially during periods when the plants begin to bloom or start to bear fruits. Compost teas can also be sprayed on lawns to stimulate the grass to grow and fill-in the bare spots.

For more information

A VFG-Compost booklet is available for $x.xx and can be obtained by at the following address:

blangenb