OVERVIEW

INTERNATIONAL BIO-RECOVERY CORPORATION

"CHANGING WASTE INTO RESOURCES"

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International Bio Recovery Corporation
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INTERNATIONAL BIO RECOVERY CORPORATION - OVERVIEW

IBR is a Canadian company that has developed an efficient process to convert biodegradable waste into useful agricultural products. The process and equipment was first proven on a pilot plant scale and subsequently using equipment of a size considered appropriate for modular commercial scale facilities of any size. The process was adapted from the Autogenous Thermophilic Aerobic Digestion (ATAD) process that is rapidly replacing other methods for the digesting of municipal sewerage sludges. Adaptations have broadened the ability of the process to handle the wide range of biodegradables commonly encountered in municipal wastes. Biodegradables from leafy plants (vegetables) can be converted to a stable useful product in approximately 36 to 48 hours, while biodegradables from woody sources, including paper waste, require processing times ranging from 48 hours to 100 hours. The process permits the feeding of a mixture of raw materials of variable digestibility; it will separate hard to digest material from the process for extended treatment. Non-biodegradables such as metals, glass, sand and plastics are segregated by a unique infeed system for recycling by others or for disposal to landfill or may be removed by cleaning and screening during the liquid phase process.

The North Vancouver plant operated by IBR, processes 55 tons per day of municipal biodegradable wastes containing up to twenty percent wood fiber-based materials including cardboard and paper. Products from the plant include a granular organic soil enhancer with an average NPK analysis of 6-1-1, and liquids with high concentrations of micro-nutrients used as the organic base to prepare liquid fertilizer preparations for hydroponic growers and for spray applications to lawns and gardens. During seasonal periods with low demand for spraying, the liquids are concentrated to become part of the solid granular product.

The North Vancouver plant uses 25, 35 and 65 ton digesters. IBR has determined that 65 is the most practical size for primary and secondary digesters. Specially designed reject digesters, used for extended treatment, continue to be most appropriately sized at 25 metric tons. Facility plans have been developed using 65 and 25 ton digester modules to satisfy the plant capacity requirements of 400 and 550 tons per day. The aeration equipment for the digesters was developed by IBR specifically for the application and is patented. IBR believes that the process can not be commercially operated without the use of this patented equipment.

The relatively small space requirements for the IBR in-vessel thermophilic digesting plant and the ability to control odour emissions permit the locating of facilities in urban settings close to the sources of prime biodegradable waste materials and potential customers. Less hauling means fewer trucks and lower waste handling costs. Complete removal of biodegradables from landfill sites would eliminate odour and leachate problems of landfills and the remaining waste could be subject to other recycling programs. The environmentally friendly conversion of waste to valuable fertilizer products give the IBR technology international appeal. IBR has received delegations from around the world to consider licensing and technology transfer.

Management

BEN VAN DIJK has been a general contractor for more than 30 years. His expertise is in the design and construction of wood frame, steel and concrete buildings. As president of Van Dyk & Sons Contractors Ltd., he had direct responsibility for project management, personnel deployment and ultimate accountability for numerous multi-lot subdivisions in Burnaby and Vancouver, exclusive custom homes, commercial and retail strip malls, New Life Community Church, as well as Pacific Academy Christian College. He has always been able to keep his projects "on time" and "on budget".

JERRY VAN DIJK has more than 25 years experience in the management of the design, construction and operation of significant pulp and paper facilities. As vice-president, and Manager of Projects for Hipp Engineering Ltd., which designs and builds pulp and paper projects around the world, he has been responsible for the management of many multi-million-dollar projects from conception to completion. He is an expert in the waste treatment of pulp and paper as well as thermophilic digesting. He has commercially developed several recycling processes including the process at *International Bio Recovery Corporation.*

DICK VAN DIJK has been a general contractor for more than 30 years. His expertise is in budget development, cost control and the construction of wood frame, steel and concrete buildings. In addition to managing Hope Reformed Church Care Society, Burnaby Cariboo RV Park Inc., New Hope Trust Fund Society and the HRC Society of Vancouver, he has been an active partner in Van Dyk & Sons Contractors Ltd. managing and building numerous multi-lot subdivisions in Burnaby and Vancouver, exclusive custom homes, commercial and retail strip malls, New Life Community Church, as well as Pacific Academy Christian College.

JOHN McLEOD, president and CEO of Active Baliff Services Ltd. since 1967. Formerly Branch Manager for Commonwealth Trust and Portfolio Manager for Laurentide Finance Corp., he has been serving the lending industry for 35 years. He is an active entrepreneur and his extensive business expertise has helped several businesses to get started.

PETER DODGE, president of UCAN Ventures Ltd. for the past 6 years, a company specializing in technology and business start-ups. He is experienced in various areas of technology and has worked with several companies with an international focus. Formerly a realtor and developer, as well as an Alderman and member on the Board of Variance, he is familiar with the political process necessary to regulate environmental change.

FAHIMEH MIRMINACHI, Ph.D., is an expert in thermophilic aerobic and anerobic fermentation. She has developed and patented unique fermentation processes that have increased production yield to maximum theoretical values. She is an expert in biochemistry, microbiology, and trace metal measurement, as well as being an accomplished project engineer. Her current research with IBR will result in several scientific breakthroughs in thermophilic digestion.

Raw Materials, Waste

A metropolitan community generates approximately two pounds of biodegradable waste per person, per day. Approximately one-third of this waste is generated by growers, wholesalers and retailers of vegetables. Another one-sixth is generated in the form of leftovers by restaurants. The remainder is generated by households. Without residential curbside recycling an IBR plant can expect one pound of biodegradable waste per person / per day. But with curbside recycling this content can double. The North Vancouver plant charges $10 less than the current tipping fees to attract the waste haulers. The North Vancouver plant capacity has always been filled immediately at $55 per ton. The centralized location of the plant substantially reduces hauling time.

Products

On average, green biodegradables contain between 70 and 90 percent water while paper products contain only 10 percent water. The water/solid balance in the plant can therefore be affected by the mix of green biodegradables and paper wastes. The solid products are dried to 5 percent water content. For each ton of solid product, slightly more than 1 ton of water is evaporated in the drying process. 1 ton (2200 pounds) of raw material input on average results in the following products (in pounds):

Source	green waste	paper waste	80/20 mix
other recyclables and waste	209	11	220
solid fertilizer	191	407	598
water vapor to atmosphere	585	22	607
liquid fertilizer	775	0	775
	1760	440	2200

As can be seen, reduced seasonal requirements for liquid fertilizer can be accommodated for by running a higher paper content, however, this also results in a slight reduction in plant intake capacity.

IBR fertilizer is retailed as "Seasons" Lawn Fertilizer for $20 per 10 kg package. IBR sells in bulk to fertilizer producers and large volume end users at wholesale prices of $350 per ton. Bulk liquid fertilizer sells to lawn care companies for $200 per ton. Retail sales will climb as consumers recognize the strength of IBR fertilizers, their recycled quality as well as their organic nature. Effective marketing will enhance the full retail value.

For production details and for product analysis and growing trial results see the report provided by the BC Research Institute.

Organic Fertilizer

International Bio Recovery Corporation (IBR) has developed a series of granular solid products, all of which have proven to be high grade organic commercial fertilizers. A research program was designed to determine the effect of IBR fertilizers on the growth of Pencross bent grass sod. The treatments were also designed to guide IBR in the potential use of field application rates. IBR Solid Organic Fertilizer (6-1-1) and IBR chemically enhanced Liquid Organic Base Soil Restorer (Compost Concentrate 6-4-5) were the two products applied repeatedly at three week intervals to pots of turf being grown in a typical greenhouse environment. Two conventional chemical fertilizers were also included for comparison purposes. The application rate used for the commercial fertilizers was based on delivering 1 lb. of nitrogen per 1000 sq. feet for each application period as per the manufacturers specifications. The IBR products, in addition to being tested at this level, were also tested at one-half and one-quarter of these levels. Fertilizer was applied at three week intervals for a total of fifteen weeks. All the grass produced was harvested prior to each application of fertilizer.

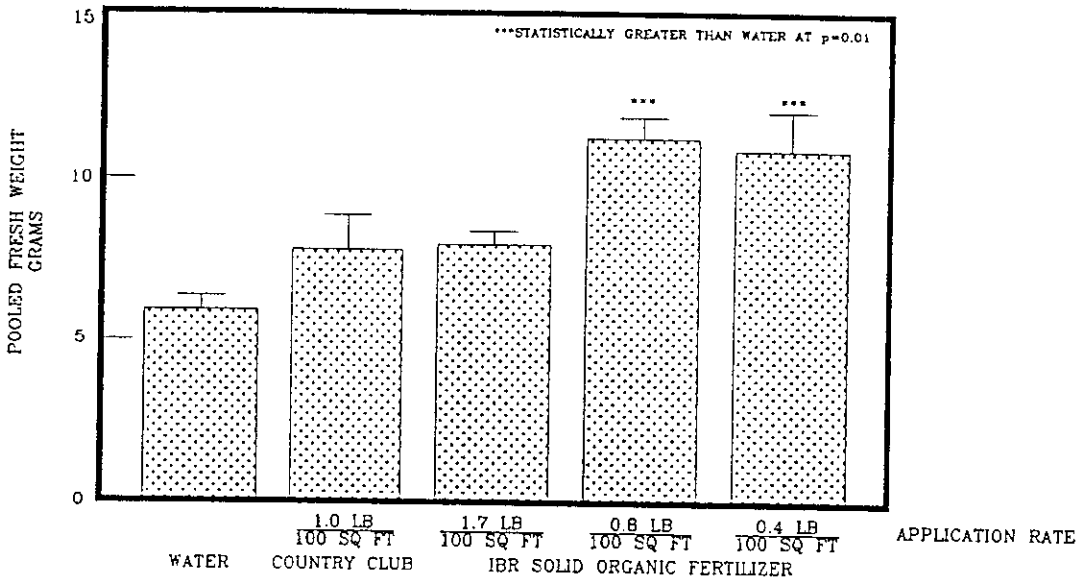
Both the Solid Organic Fertilizer and the Liquid Organic Soil Restorer increased the fresh and dry weight of clippings taken when compared to turf that received only water. The classical response to various concentrations of fertilizer was observed for both the IBR products. In addition, both of the IBR fertilizers produced fresh and dry weights that were comparable to or better than commercial fertilizers such as Country Club (10:18:18) and Peters (30:10:10). In fact, for several harvests only one-half or one-quarter of the Solid Organic Fertilizer were required to produce a similar response to the commercial fertilizer. Furthermore, repeated applications of both the solid and liquid IBR products did not result in a toxic effect which appeared in the treatment with one of the chemical fertilizers. The chemical fertilizer toxic effect was expressed in a general yellowing and decline in the amount of grass produced (see BC Research graph).

Initial IBR marketing plans for organic fertilizer is to focus on bulk sales to lawn maintenance companies, organic farmers, hydroponic growers, golf courses, and municipalities. A marketing agreement has been reached for retail sales under "Seasons" Lawn Fertilizer. Consumer demand should increase with the awareness of IBR fertilizers being organic, derived from biodegradable recycling, as well as being better than the best chemical fertilizers available. IBR can very profitably market organic fertilizers at lower cost than its chemical counter-parts. However, usage shows that less IBR fertilizer is required for better results and the price will ultimately be determined by market demand.

UBC growing trials conducted by BC Research

PENCROSS TURF–SOLID FERTILIZER

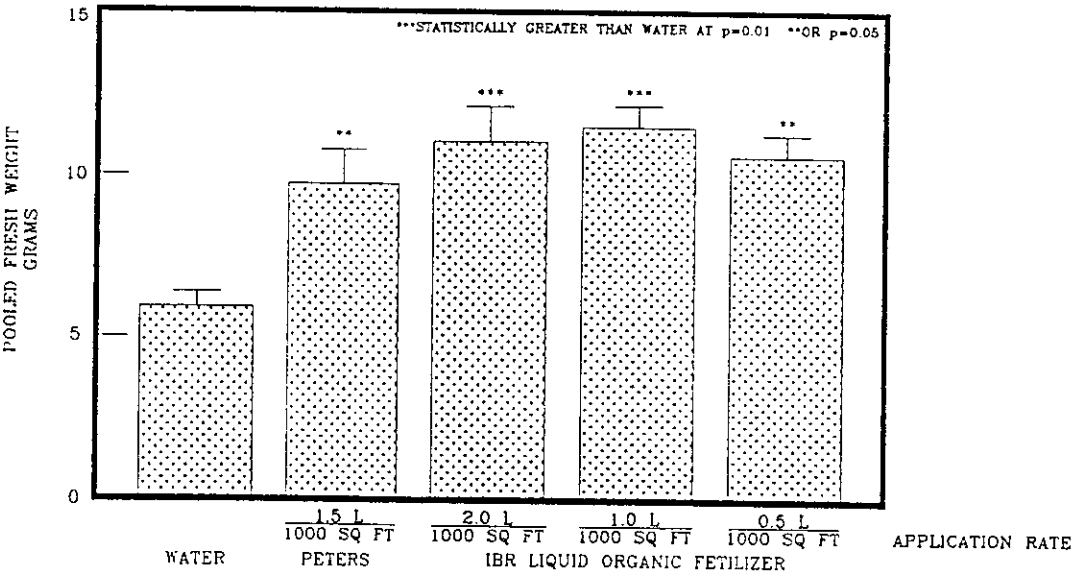
FIGURE 1



Control: Water,Country Club Fertilizer applied to manufactures specification.
When IBR fertilizer was applied with equal nitrogen concentration to Pencross Turf in controlled growing trials at UBC, IBR had better results than Country Club. When the concentration was cut to 50%, IBR's performance was considerably better and when the concentration was cut to 25%, its performance was also much better than with Country Club. This results from the increased microbial activity in the soil caused by using IBR fertilizer.

PENCROSS TURF– LIQUID FERTILIZER

FIGURE 2



Control: Water,Peters Fertilizer applied to manufacturers specification.
Liquid fertilizers are soluble by nature and are more quickly available for plant growth. IBR liquid fertilizer showed better results than Peters when the nitrogen content was equal, and also when concentration was cut to 50% and 25% of the concentrations of Peters. Both solid and liquid IBR organic fertilizers increase microbial activity in the soil between 200 and 600%. This fortifies the soil with micronutrients in the exact proportion required to stimulate growth.

The Plant

Digesting takes place at six percent solids which means that 10/6 = 1.67 tons of digester is needed to process 1 ton of green waste. Three days of processing time, plus 10 percent for inoculation = 1.67 x 3 x 1.1 = 5.5 tons of digester space per ton of green waste. A 150 ton clean waste plant therefore requires (150 x 5.5) ÷ (65 x 1.1) equals a total of 11 primary and secondary digesters and two 25 tons reject digesters. Space requirements for this 14 digester size plant (150 tons of green waste) include:

26,000 sq.ft. building space
7,500 sq.ft. outside tankage space area
30,000 sq.ft. load and yard area

This space requirement includes room for:

- unloading and storage
- processing
- bagging
- warehousing
- scrubbing
- office space
- shop space
- loading area

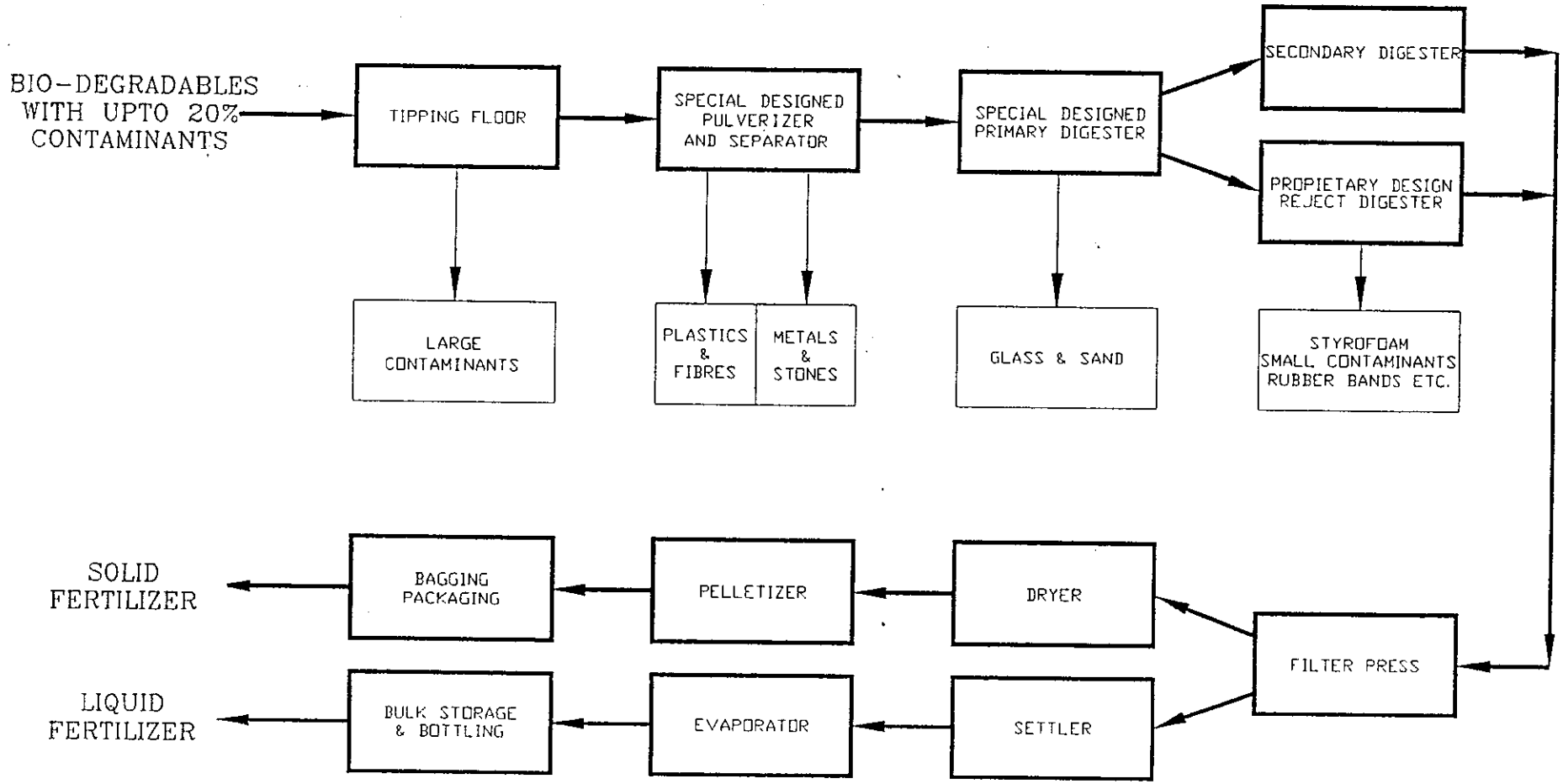
The attached sketches illustrate a simplified process and plant layout. For plants of larger capacity the digesting space requirement can be directly prorated to capacity. Other space can be prorated on a square foot factor basis.

An IBR plant discharges air that contains regulated pollutants as well as potentially odious gasses. All off-gasses including plant air changes are collected for purposes of scrubbing in a biofilter. Extended operation has demonstrated to the satisfaction of regulatory authorities and close neighbours that a properly operated plant (all portions are kept aerobic) can be kept well within allowable emission levels.

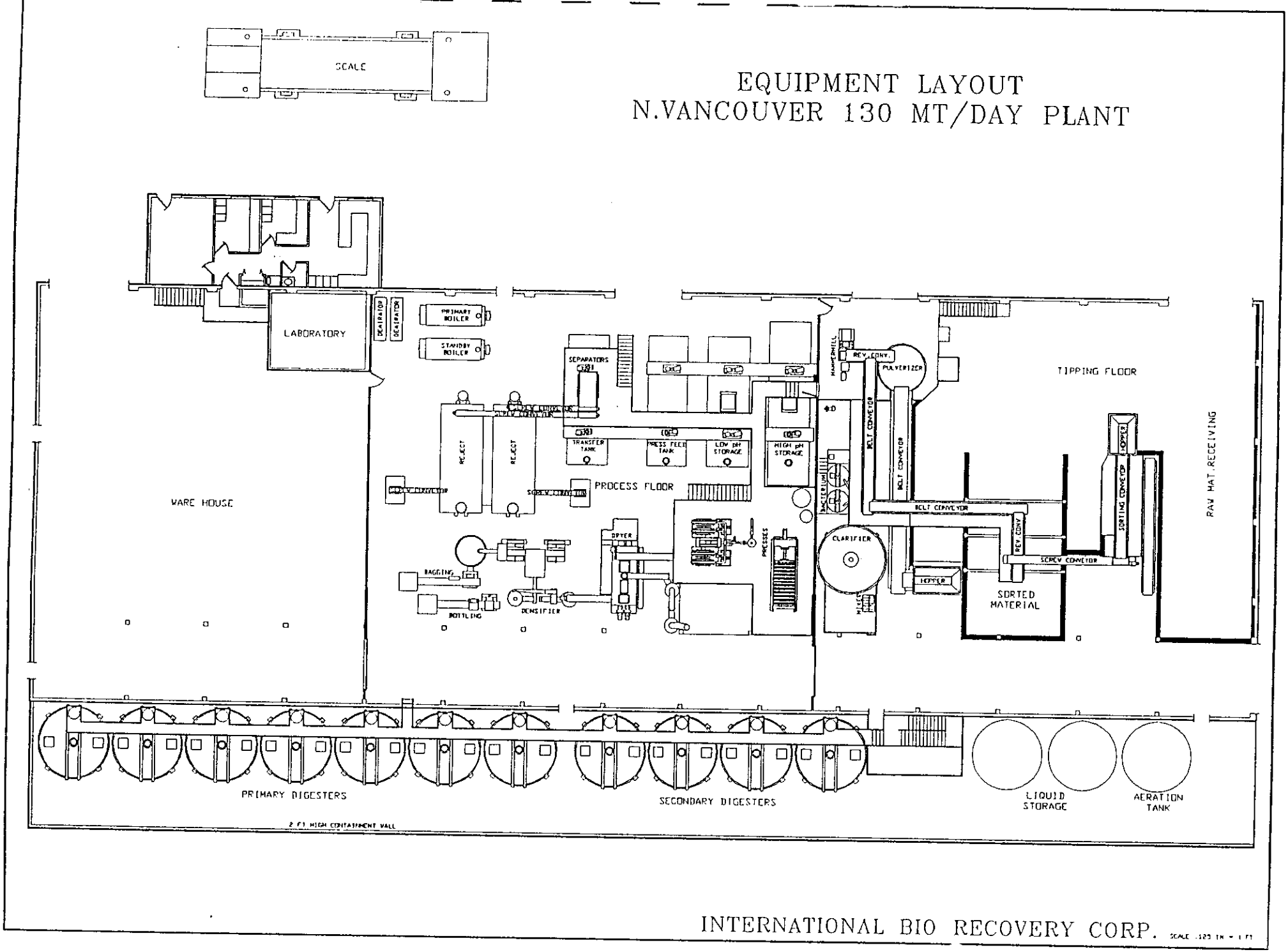
Environmental Permits Issued

IBR is operating under a closely monitored environmental permit. The regulatory agency responsible for the monitoring of all aspects of permit conditions has determined IBR's complete compatibility with industrial neighbors and residences within a 500 ft. radius, and has issued standard permits to operate. IBR has demonstrated to neighbouring residents and the Greater Vancouver Regional District (GVRD) that the IBR process can be controlled to maintain full air quality compliance at all times. The greatest source of possible nuisance is the transport of raw materials to the plant. At the plant, trucks are unloaded in an environmentally controlled building that maintains a slight negative pressure. Air-for-air changes are scrubbed to eliminate odours using biofilters. Incoming material is sorted and slurried as quickly as possible and pumped to the enclosed digester vessels. Off-gasses from the aerobic digesters are scrubbed by filters used for building air discharge control. The permits to operate a commercial scale facility allows IBR to operate a 150 metric tons per day infeed capacity, appropriate for the location. Having obtained permits from the GVRD, IBR should have no difficulty in obtaining permits in other jurisdictions for any size plant.

PROCESS OVERVIEW



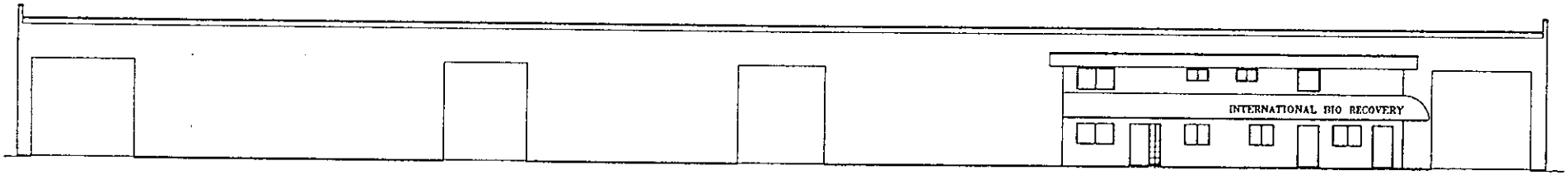
INTERNATIONAL BIO RECOVERY CORP.



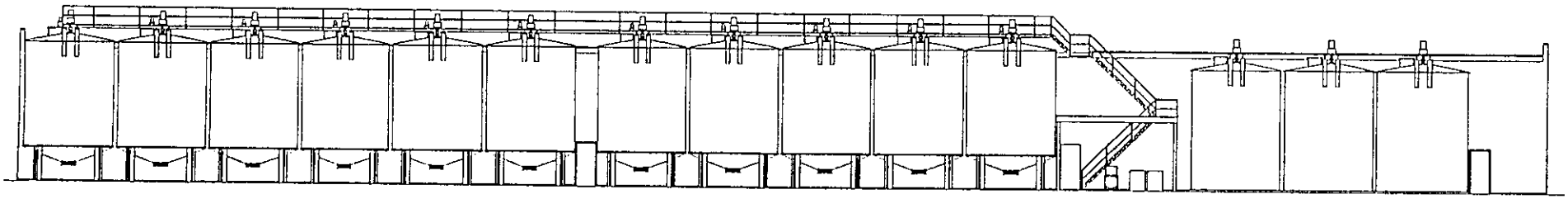
EQUIPMENT LAYOUT
N.VANCOUVER 130 MT/DAY PLANT

INTERNATIONAL BIO RECOVERY CORP. SCALE .125 IN = 1 FT

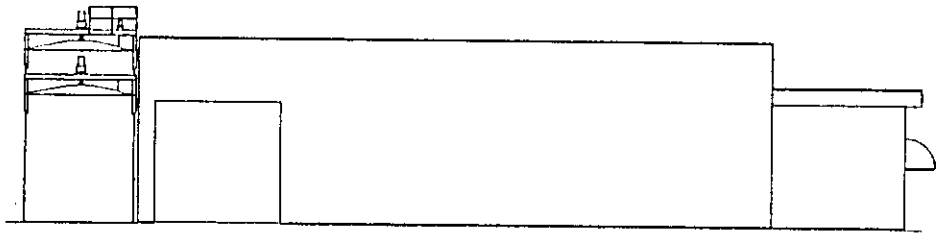
ELEVATION PLAN
130 MT/DAY IBR PLANT
N. VANCOUVER



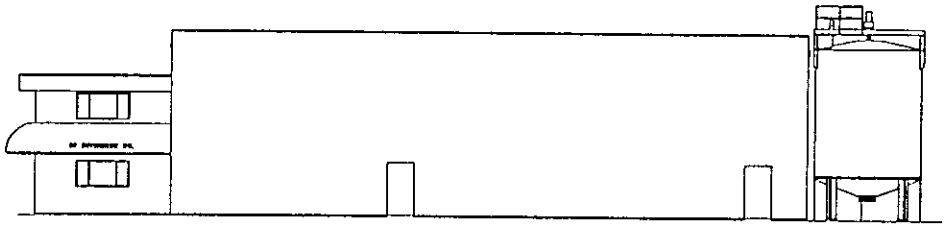
NORTH ELEVATION



SOUTH ELEVATION



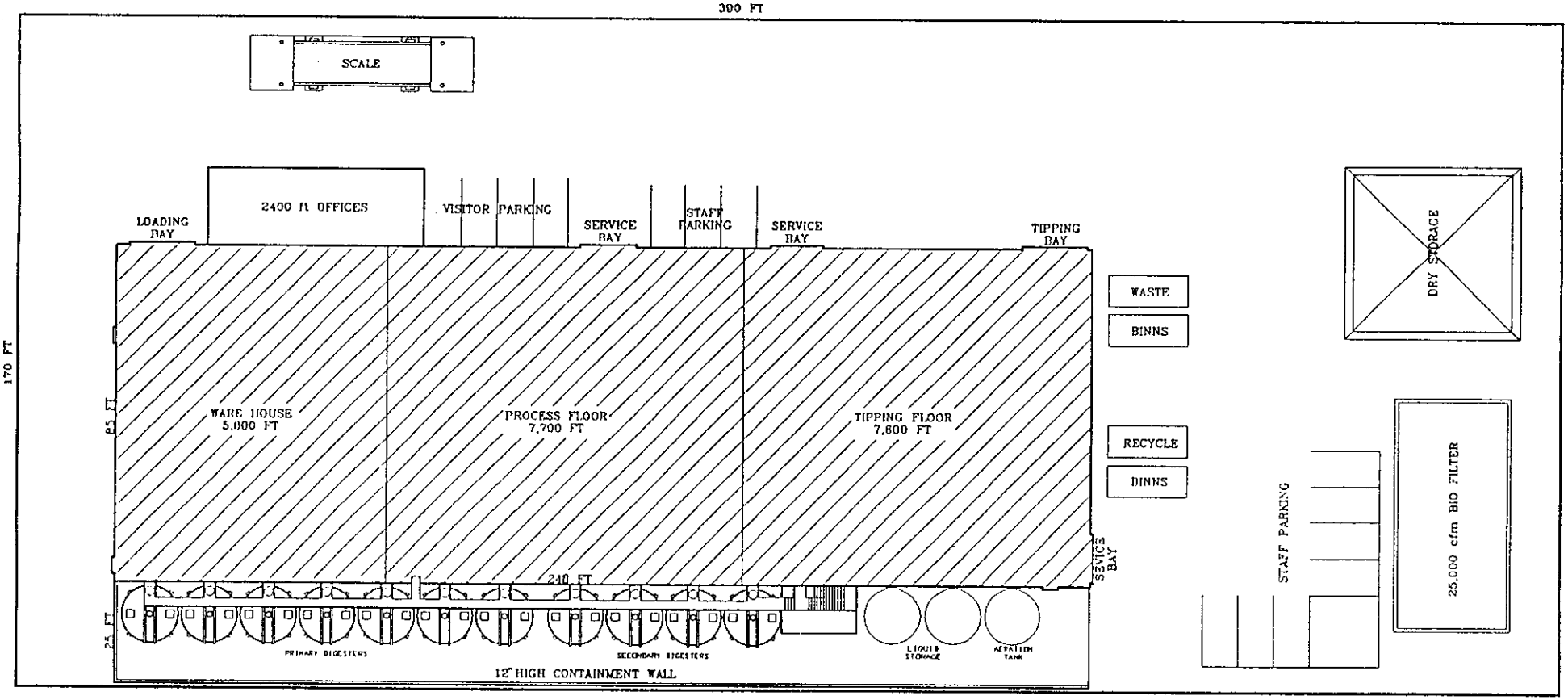
EAST ELEVATION



WEST ELEVATION

INTERNATIONAL BIO RECOVERY CORP

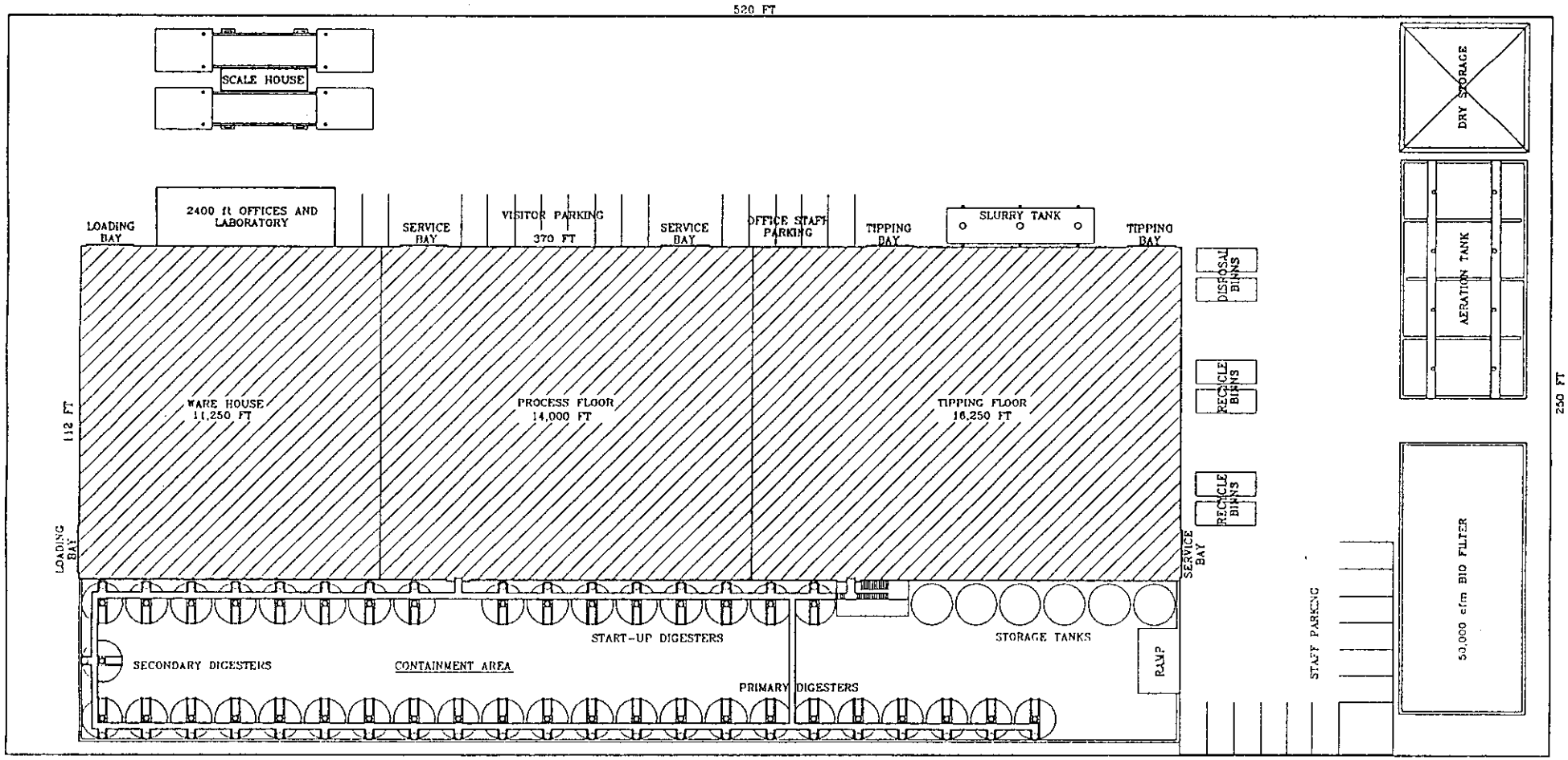
TYPICAL SITE PLAN
130 MT/DAY IBR PLANT
N.VANCOUVER



PLANT FOOT PRINT	21,000 FT
CONTAINMENT AREA	6,200 FT
SITE AREA	66,300 FT = 1.52 ACRES

INTERNATIONAL BIO RECOVERY CORP.

TYPICAL SITE PLAN
450 MT/DAY IBR PLANT



PLANT FOOT PRINT 41,500 FT

CONTAINMENT AREA 20,350 FT

SITE AREA 130,000 FT = 3 ACRES-

INTERNATIONAL BIO RECOVERY CORP.

INTERNATIONAL BIO RECOVERY CORPORATION

PLANT COSTS 130 TON / DAY
100 Ton Biodegradable and 30 Ton Waste (Cardboard and Contaminants)

Excluding costs re:	site, land, site servicing, local engineering permitting fees and applicable taxes, interest on capital and other costs specific to locale	$8,000,000

PLANT BASE CASE INCOME

Tipping Fees	130T x 350 x $ 55.00	$2,502,500	
Bulk Solid Fertilizer	4T x 350 x $350.00	490,000	
Retail Solid Fertilizer	2T x 350 x $500.00	350,000	
Bulk Liquid Fertilizer	12T x 350 x $200.00	840,000	
Retail Liquid Fertilizer	2T x 350 x $400.00	280,000	
Cardboard Pellets	35T x 350 x $25.00	306,250	
			$4,768,750

OPERATING COST

Permits & Licenses	$10,000	
Waste Disposal	130,000	
Rent	110,500	
Hydro Electricity, Gas	565,000	
Bio Filter	25,000	
Front End Loader	72,800	
Insurance	11,200	
Office Supplies	40,000	
Chemicals	140,000	
Laboratory Work	35,000	
Salaries	1,075,000	
Maintenance	250,000	
Management	100,000	
		$2,564,500
Net Operating Income		**$2,204,250**

INTERNATIONAL BIO RECOVERY CORPORATION

PLANT COSTS 225 TON / DAY
185 Ton Biodegradable and 40 Ton Waste (Cardboard and Contaminants)

Excluding costs re:	**site, land, site servicing, local engineering permitting fees and applicable taxes, interest on capital and other costs specific to locale**	**$11,000,000**

PLANT BASE CASE INCOME

Tipping Fees	185T x 350 x $ 55.00	$3,561,250	
Bulk Solid Fertilizer	7.4T x 350 x $350.00	906,500	
Retail Solid Fertilizer	3.7T x 350 x $500.00	647,500	
Bulk Liquid Fertilizer	22.2T x 350 x $200.00	1,554,000	
Retail Liquid Fertilizer	3.7T x 350 x $400.00	518,000	
Cardboard Pellets	50T x 350 x $25.00	437,500	
			$7,624,750

OPERATING COST

Permits & Licenses	$20,000	
Waste Disposal	200,000	
Rent	145,000	
Hydro Electricity, Gas	925,000	
Bio Filter	42,000	
Front End Loader	116,000	
Insurance	20,000	
Office Supplies	55,000	
Chemicals	70,000	
Laboratory Work	55,000	
Salaries	1,750,000	
Maintenance	450,000	
Management	150,000	
		$3,998,000

Net Operating Income	**$3,626,750**

INTERNATIONAL BIO RECOVERY CORPORATION

PLANT COSTS 450 TON / DAY
400 Ton Biodegradable and 50 Ton Waste (Cardboard and Contaminants)

Excluding costs re: site, land, site servicing, local engineering permitting fees and applicable taxes, interest on capital and other costs specific to locale **$18,000,000**

PLANT BASE CASE INCOME: (Projected Net Revenue)

Tipping Fees	450T x 350 x $ 55.00	$8,662,500	
Solid Fertilizer (Bulk)	19T x 350 x $350.00	2,327,500	
Solid Fertilizer (Retail)	9T x 350 x $500..00	1,575,000	
Liquid Fertilizer(Bulk)	48T x 350 x $200.00	3,360,000	
Liquid Fertilizer (Retail)	8T x 350 x $400.00	1,120,000	
Cardboard Pellets	50T x 350 x $25.00	437,500	
			$17,482,500

PROJECTED OPERATING COST

Permits & Licenses	$30,000	
Waste Disposal	475,000	
Rent	225,000	
Hydro Electricity, Gas	2,100,000	
Bil Filter	100,000	
Front End Loader	250,000	
Insurance	40,000	
Office Supplies	100,000	
Chemicals	280,000	
Laboratory Work	100,000	
Salaries	3,500,000	
Maintenance	1,000,000	
Management	300,000	
		8,500,000

Net Operating Income **$8,982,500**

INTERNATIONAL BIO RECOVERY CORPORATION

Technology Transfer

International Bio Recovery (IBR) will provide the process engineering and construction drawings for the complete plant. IBR will provide proprietary equipment and will specify auxiliary equipment and systems for purchase from other vendors in close cooperation with the Plant Owner/Operators. IBR will coordinate the assembly of operating and maintenance instruction manuals for all plant equipment.

IBR will train operators selected for adequacy of basic skills in the operation of the plant and plant equipment through classroom instruction and supervision during initial operations.

Direct cost fees to IBR for the above goods and services are similar for plants of all sizes and will vary only because of differences in site conditions and local infrastructure. Average costs as a percentage of constructed project costs are:

Proprietary equipment cost	10%
Process engineering and construction drawings	12%
Operator training & construction supervision	3%
Start-up assistance	3%
Total IBR Goods and Services:	28%

Constructed Plant Costs

The cost of the Plant as constructed will vary somewhat with the specific location due to factors such as:

- Site condition
- Local permitting and construction requirements
- Available infrastructure
- Transportation methods and terminals
- Local labour rates and efficiencies

Average costs for Plants as constructed but not including:

- Cost of land
- Interest on capital
- Financing costs
- Development costs including permitting
- Supply or marketing development costs are approximately $60,000 to $40,000 per incoming ton of material,

  i.e. a 130 Ton/Day Plant is $8,000,000
  225 Ton/Day Plant is $11,000,000
  450 Ton/Day Plant is $18,000,000

IBR Technology Fees

IBR is prepared to sell technology and operating rights for plants and/or geographical regions without equity participation in the plant or operation. Fees for such an arrangement include an up-front Technology Transfer Fee of $2,250.00 per incoming daily ton of plant capacity and a processing fee paid quarterly for ten (10) years of $5.00 per ton of incoming material processed.

IBR Equity Participation

IBR is prepared to reinvest up to twenty-five percent (25%) of the total fees payable to IBR through construction for Goods and Services as well as Technology Rights as equity in any commercially structured plant.

IBR is under the right circumstances and with approved compatible local partners prepared to increase its equity participation to a controlling interest.

File: Transfer

THERMOPHILIC AEROBIC DIGESTION OF FOOD WASTE BY INTERNATIONAL BIO RECOVERY CORPORATION

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Project No.: 2-51-0736

August 24, 1994

Thermophilic Aerobic Digestion of Food Waste By International Bio Recovery Corporation (IBRC)

IBRC operates a pilot scale liquid composting plant in North Vancouver. This plant digests waste biodegradable material, which normally goes to landfill, and produces valuable natural organic solid and liquid fertilizers. The advantages of this process over the conventional composting methods is total recovery of nutrients and micronutrients, a fast and controlled digestion of the waste, the assurance that there are no pathogens in the products, total control over odors and the products are free from contaminants normally found in products from conventional composting.

BCRI was commissioned by IBRC to assess the technical feasibility of operating the plant, to evaluate its conversion efficiency, to monitor the production of fertilizer by the IBRC process, and to evaluate the two fertilizer products.

IBRC in North Vancouver, B.C. is presently operating a pilot plant for conversion of vegetable and fruit waste to value added organic products. The company uses a thermophilic aerobic digestion process for the waste conversion.

This report describes the operation of IBRC during a typical batch run and presents the results of the liquid and dried products as fertilizers or soil additives. The test was conducted at the pilot plant during the period between July 4 and 11, 1994.

Over a period of three days, a total of 40 tonnes of vegetable and fruit waste was delivered to the IBRC pilot plant. The waste was processed and used for the thermophilic aerobic digestion experiment. The waste contained approximately 85% vegetables and fruit matter and 15% non-vegetable matter. Among the non-vegetable matter, approximately 70% were large objects such as waxed and non-waxed cardboard and wooden crates. The remaining 30% of the contaminants were small objects such as plastic bags, rubber bands, twist ties, fruit baskets, rubber gloves, bottle caps, staples, metals, etc. Prior to substrate preparation the large non-vegetable objects were removed manually. To process 14 tonnes of waste per hour, one front end loader and two men were required, using this hand sorting procedure. More tipping floor space is required if the company expands its operation to process up to 100 tonnes of waste per day. The small contaminants were removed by mechanical means prior to and during digestion. The plant is capable of removing contaminants efficiently from waste containing 25% non-vegetable matter. The removal of small non-vegetable contaminants from the slurry has made possible the production of unusually clean end-products free of metals, plastics and glass.

To optimize the substrate for thermophilic aerobic digestion, the particle size of the waste was reduced and the waste was diluted with the filtrate generated from the previous batch digestion. Thus, the liquid used in the process was recycled. No process effluent was discharged from the plant. Throughout the size reduction process operating parameters such as the pH, particle size and slurry consistency were monitored continuously. The consistency of the slurry was controlled by the amount of filtrate added to the vegetable matter. Suitable slurry consistency was made according to the handling capacity of the slurry transfer pumps. The size reduction equipment was capable to process 40 tonnes of material in three hours. Approximately 1/2 hour was needed to clean and dispose off non-vegetable matter. At present, the size reduction unit is capable of processing 100 tonnes of waste per day. In future, however, if the operation expands to commercial-scale, a back up unit will be required.

Results of chemical analyses showed that the substrate contained 5.8% total solids, 3.5% total volatile solids and 94.2% moisture content. The dried matter consisted of 344 g BOD/Kg, 711 g COD Kg, 21.1 g N/Kg, as TKN, 5.5 g N/Kg as ammonia, 2.5 g P/Kg as total phosphorous, 2 g P/Kg as ortho-phosphorous and 48.8 g k/Kg as total potassium (Table 1).

The slurry substrate was digested aerobically in closed vessels. To enhance aerobic oxidation two stages of digesters were used. Air was introduced into the digesters at a predetermined rate to create an aerobic environment for bacterial growth. In addition, the waste slurry in the digester was mechanically agitated continuously to provide sufficient mixing and surface contacts together with readily available oxygen for optimum metabolizing or digesting the biodegradable organic material. To accelerate the digestion process, the starting temperature of the slurry was raised to the usual thermophilic digestion temperature range. Once the thermophilic bacteria started to grow the temperature was maintained by the heat generated from bacterial metabolism. Throughout the digestion process the temperature, pH, air flow and slurry substrate volume were monitored and recorded.

The slurry substrate was first digested for 48 h in a 60 tonne primary digester. The partially digested slurry was transferred into two 30 tonne secondary digesters and incubated further for another 24 h. At present the company is equipped with one 60 tonne primary digester and two 30 tonne secondary digesters capable of processing 40 tonnes of food waste easily every four days. For commercial production IBRC foresees the need for seven primary and five secondary digesters.

After digesting the slurry for a total of 72 hours, it was dewatered in a filter press, dried, screened, and stored. The filtrate from the press was clarified and stored.

During this process, the slurry, dried product and filtrate were analyzed for five-day biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), total solids (TS), total volatile solids (TVS), total Kjedahl nitrogen (TKN), nitrate, ammonia, potassium, ortho-phosphate and total phosphorous.

The primary digester removed 16% BOD_5 after 24 hours, 35% after 36 hours and 39% after 48 hours (Table 2 and Figure 1). Further BOD_5 removal was demonstrated after secondary digestion resulting in a final BOD_5 removal of up to 62%. These result show that organic material was readily biodegraded throughout the digestion process. Also, up to 37% volatile solids were removed (Table 3 and Figure 2).

The digested organic products were separated into solid and liquid portions. Results showed that high fertilizer values were found in both solid and liquid products (Table 4). Part of the end products was enriched with cardboard and nutrients. Samples of the end product with and without cardboard and nutrient addition were tested for their fertilizer value. Results indicated non-enriched solid product was found to be comparable or even contained higher nitrogen, phosphorous and potassium values than commercial organic fertilizers (Table 4). The non-enriched solid product (without cardboard) contained approximately 4.1% nitrogen and the enriched material 8.3%. Total phosphorous and potassium levels did not increase significantly by enrichment. The non-enriched liquid product contained only 0.02% nitrogen and 0.3% potassium and non-detectable levels of phosphorous. When the liquid product was enriched with nutrients an increase of up to 3% nitrogen, 0.02% phosphorous, and 1.2% potassium were detected. Heavy metals were not present in the end products at concentrations that are considered to be harmful to plants (Table 5). In fact they were significantly lower than those in sewage sludge composts and fertilizers.

One outstanding feature of the digested organic end product is its clean fertilizer appearance. No foreign objects such as glass, metal chips, or rubber bands can be seen. This is important for a product to be used as fertilizer or soil additive, because their presence may be harmful to the soil.

Based on the preliminary results of this study, the following conclusions and recommendations for future studies may be drawn:

- The thermophilic aerobic digestion process has successfully produced a clean totally organic solid and liquid product which contains high fertilizer values.
- Biological metabolic activity during digestion has raised the temperature of the fermenting slurry and maintained high temperature throughout the fermentation process. It is expected that this high temperature would kill disease causing agents and weed seeds.
- Nutrients of the original plant materials have been conserved.
- Destruction of disease causing microorganisms and weeds and the conservation of nutrients are not the only advantages of this unique digestion process for recycling of food wastes. Many gardeners claim that organic fertilizer grown plants are healthier and produce sweeter fruits than those grown with inorganic fertilizer. This is probably due to the conservation of micronutrients, such as nickel, manganese, and zinc in the digested organic product. These trace metals are not replaced by conventional fertilizers.
- The digested organic product may improve the soil structure. Microorganisms form the soil particles into crumbs that retain water; this improves air circulation within the soil and makes soil cultivation and root penetration feasible.
- Most plant growth media are based on peat to which may be added grit, sand or other bulking agents. Addition of nitrogen and other inorganic nutrients including phosphorous, potassium and trace elements gives the base medium that promotes germination and root growth. The material should have a good water holding capacity, and porosity as well as free drainage and stable structure. Medium grade sphagnum peat are used commercially but they are becoming increasingly scarce. Therefore, an inexpensive, easily-produced material which possesses some properties of peat would be an ideal substitute. The product produced by IBRC appears to possess most of these properties. However, the company has not yet conducted growth studies. Prior to any conclusion can be drawn, a well designed program for plant growth trials is recommended. The results would confirm the expectation that the product is actually desirable to be used as plant growing medium.

- There are a number of possible potential markets for the digested organic product, including organic growers who presently have no totally organic seedling and potting soils. IBRC's product may also be used extensively as tree or shrub planting medium as well as an all purpose plant growth medium. Other potential use of the product may include animal and fish feeds. To up-grade the value of the product, other alternative processes may be developed. For example, enhanced vitamin and protein production may be possible, using vermiculture technology.

Table 1: Characteristics of Substrate Feed

Parameter	Substrate
pH	6.5
Total Solids (%)	5.8
Total Volatile Solids (%)	3.6
Moisture (%)	94.2
BOD_5 (g/Kg)*	344
COD (g/Kg)*	711
TKN (g/Kg)*	21.1
NH_3 (g N/Kg)*	5.5
Total P (g P/Kg)*	2.5
Ortho P (g P/Kg)*	2
Total K (g K/Kg)*	48.8

* Based on dry weight

Table 2: BOD Removal Profiles at Various Digestion Times

Time (h)	BOD_5 (Kg)	BOD_5 Removal (%)
Start	892	0
12	896	0
24	753	16
36	576	35
48	557	39
72	338	62

Figure 1. **BOD Removal Profiles at Various Digestion Times**

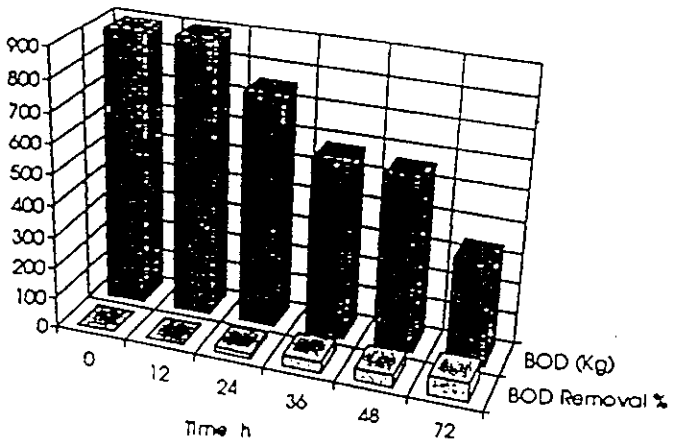

Table 3: Volatile Solids Removal at Various Digestion Times

Time (h)	Volatile Solids (Kg)	Volatile Solids Removal (%)
Start	1695	0
12	1545	9
24	1455	14
36	1381	19
48	1335	21
72	1069	37

Figure 2. **Volatile Solids Removal at Various Digestion Times**

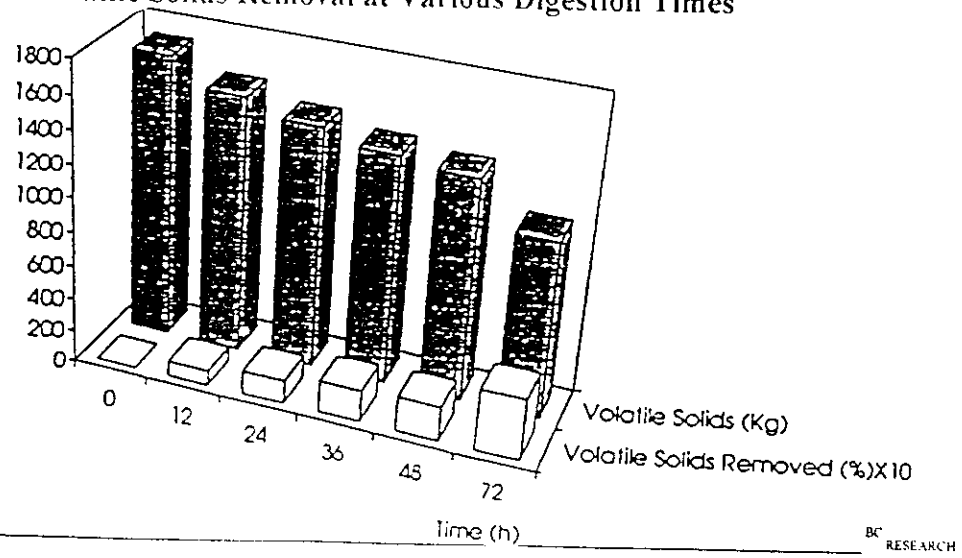

Table 4: Comparative Fertilizer Value of IBRCs Organic Fertilizer, Commercial Composts, and Commercial Organic Fertilizers

Type of Fertilizers	Total Nitrogen (%)	Total Phosphorous (%)	Total Potassium (%)
IBRCs End Product (no cardboard; no nutrients) *	4.1	1.0	1.5
IBRCs End Product (no cardboard; + nutrients) *	8.3	1.2	1.4
IBRCs End Product (+ cardboard; and nutrients) *	8.7	0.7	0.8
IBRCs End Product (+ cardboard; no nutrients) *	5.4	1.4	2.0
IBRCs Clarified Filtrate (no nutrients) **	0.02	<0.001	0.3
IBRCs Clarified Filtrate (+ nutrients) **	3.0	0.02	1.2
Wood Chips/Raw Sewage (Beltville) **	1.0	N/A	0.2
Municipal Waste/Digested Raw Sludge (Lodi) **	0.8	0.03	0.4
Bedding Materials/Cow Manure (Fertlife™) *	1.0	1.0	1.0
Worm Castings *	1.6	0.1	0.02
Bone Meal/Dried Blood (Garden Food™) *	5	5	5
Dried Sewage (Milorganite™) *	6	2	0

* Based on g/Kg dry weight
** Based on g/Kg wet weight
N/A Not Available

Table 5: Comparative Heavy Metal Composition of IBRCs Organic Fertilizer and Sewerage Sludge Organic Fertilizers

Name	Arsenic	Cadmium	Chromium	Copper	Nickel	Lead	Zinc
IBRCs End Product (no cardboard; no nutrients) *	<3	<1.4	5	5	4	6	41
IBRCs End Product (no cardboard; + nutrients) *	<3	<1.3	6	4	5	6	37
IBRCs End Product (+ cardboard; and nutrients) *	<2	<1.1	2	2	1.6	<2.1	19
IBRCs End Product (+ cardboard; no nutrients) *	<3	<1.5	4	4	4	<3.1	33
IBRCs Clarified Filtrate (no nutrient) **	<0.2	<0.1	<0.1	<0.1	<0.1	<0.2	0.1
IBRCs Clarified Filtrate (+ nutrient) **	<0.2	<0.1	<0.1	<0.1	0.5	<0.2	0.7
Sewage Sludge Composts *	N/A	8	N/A	300	55	290	770
Sewage Sludge Organic (Milorganite™) *	<33	35	5,000	390	141	276	1,000
US. EPA Limits* (2)	N/A	10	1,000	1,000	200	700	2,000

* Micrograms per gram dry weight
** Micrograms per gram wet weight
N/A Not Available

north shore news

NOVEMBER 23, 1997

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The problem is so immense a
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ly makes a dent into the
oblem," he said.
Van Dyk said 200 tonnes of
he waste are available on the
Shore every day but spring

NEWS photo Mike Wakefield

INTERNATIONAL Bio Recovery Corporation's (left to right) Jerry Van Dyk, Peter Dodge, Ben Van Dyk, John McLeod and Dick Van Dyk don't look at biodegradable waste as garbage.

Company to go public

From page 1

up the [illegible] and means to access [illegible] time. He called [illegible] recycling plant the missing link [illegible] recycling system because "we really have no effective process to handle biodegradable waste," he said.

Currently, 30% to 32% of [illegible] biodegradable.

Van Dyk says his waste reduction technology has another benefit — it keeps biodegradable waste that [illegible] es odors and leachate out of landfills.

"We take that garbage, we do this in a completely enclosed system so we have no odors, [illegible] produces out of that organic fertilizer. It is completely [illegible] nature's way."

Even though the garbage that goes [illegible] inevitably includes rat poisons and pesticides, they are [illegible] ken down by microbes in the process and rendered [illegible] less, said Van Dyk.

Although the plant currently operates at 50 tonnes, the plant hopes to have 11 [illegible]-tonne "digesters" [illegible] a year.

So far, the plant has cost approximately $5 [illegible] the four year research and development [illegible] government grants, tax breaks and National Research Council grants have provided $800,000. A [illegible] $80 investors also kicked in cash.

The company is in the process of going public [illegible] seeking listings on the Vancouver Stock Exchange, Toronto Stock Exchange or Nasdaq.

Van Dyk said "quite a few other jurisdictions" have already scrutinized the plant, which can earn revenue through tipping fees and fertilizer sales. Although negotiations continue, no deals to build new plants have been signed, said Van Dyk. He said the fertilizer product does not contain chemical fertilizer and is environmentally safe.

Mountain marketing vice president Peter Dodge says fertilizer sales are beginning this spring under the name Supreme Lawn Fertilizer through Welcome Harvest Farms, a Tsawwassen-based manufacturer of organic fertilizer.

He said bulk sales to larger fertilizer users such as golf [illegible] and municipalities will be pursued.

Tuesday, October 22, 1996

Loan boosts trash recycling firm

A North Vancouver firm that transforms garbage into fertilizer will be able to handle five times as much business.

GLENN BOHN
Vancouver Sun

A North Vancouver company that transforms biodegradable garbage into fertilizers got a $500,000 loan Monday to expand what it hopes will become a billion-dollar industry.

The loan will enable International Bio Recovery Corp. to handle 50 tonnes of food wastes and other organic trash daily, up from the 10 tonnes per day it now converts into liquid and solid fertilizers.

The money comes from a $30-million joint program of the federal Western economic Diversification department and the Royal Bank of Canada.

The firm performs its environmental alchemy in an old warehouse on Riverside Road just east of Second Narrows. Its next-door neighbor is a cavernous warehouse where the North Shore's garbage is handled the traditional way. Like the rest of the two million tonnes of garbage thrown out in Greater Vancouver each year, it is compacted before being dumped or burned elsewhere.

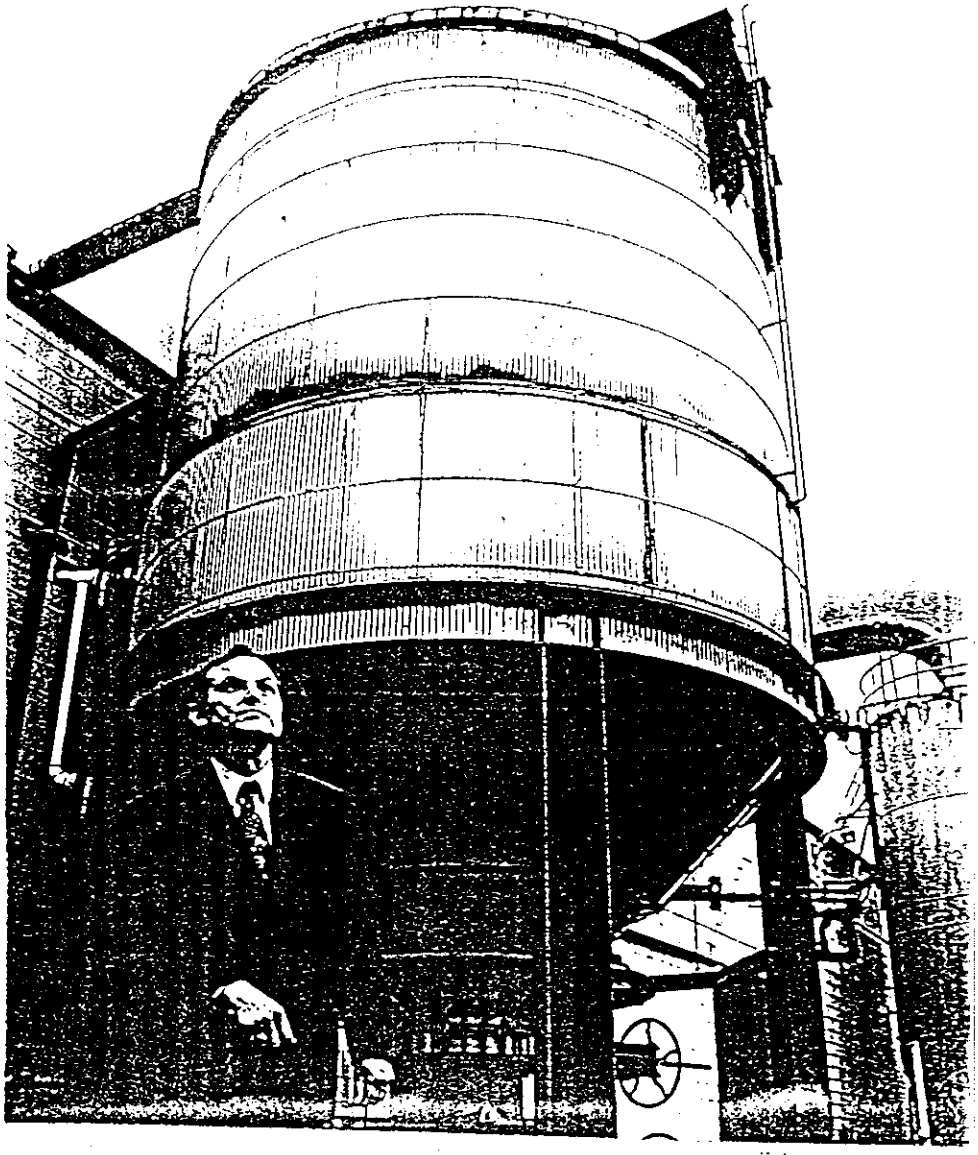
Inside huge tanks different kinds of bacteria originally taken from a pig's stomach are used in succession to digest the biodegradable material. They are "thermophilic" or heat-generating bacteria, that create 80 degree temperatures that kill disease-carrying pathogens in the waste.

Marketing vice-president Peter dodge said there are no bad odors outside the building, because it's a closed-loop processing system that uses negative air pressure to keep foul smells inside. Dodge said the firm plans to test market its fertilizer next spring and sell them cheaper than more common chemical fertilizers. He said just one-quarter of the volume of fertilizer will have to be used, because the organic fertilizer stimulates microbial activity in the soil.

Currently, despite government programs to encourage backyard composting, about one-third of Greater Vancouver's garbage is kitchen and garden wastes. That potential fertilizer is entombed in the big garbage dumps at Cache Creek, at Port Mann in Surrey and Burns Bob in Delta.

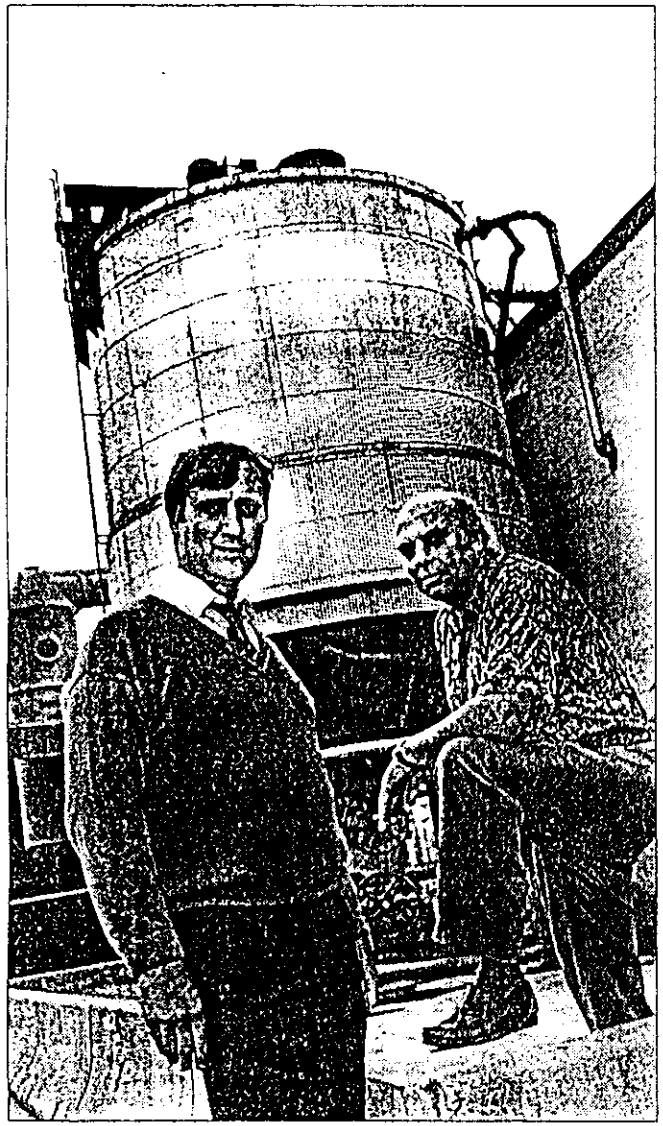
Company president Ben Van Dyk said there's nothing wrong with backyard composting,, but there may be no room at apartment and condominium buildings for composting. Van Dyk also said many people don't want to take the time and effort to do their own composting.

"We believe this industry will grow to a $20-billion or $30-billion industry in North America," said company vice-president Dick Van Dyk, one of three brothers running the firm.



IAN SMITH/Vancouver Sun
HEART OF THE OPERATION: International BioRecovery vice-president Jerry Van Dyk with digester

BUSINESS



NEWS photo Brad Ledwidge

INTERNATIONAL Bio Recovery director Peter Dodge (left) and president Ben Van Dyk hope their compa- 's pr ts v o gl n th t fe rs.

Recycling the world

Local firm spreads a vision

BY IAN NOBLE
News Reporter

INTERNATIONAL Bio Recovery (IBR) Corporation is a North Vancouver company taking the plunge into the worldwide biodegradeable recycling arena.

Looking two to three years down the road, an ambitious IBR president Ben Van Dyk said: "We hope to be all over the world."

Already, local and American municipalities have expressed an interest in IBR's technology.

IBR's end products are liquid and solid fertilizers that IBR plans to sell in bulk and through retail outlets. "Just about anywhere you use chemical fertilizers you can use ours — and it's 100% organic," said Van Dyk.

IBR director Peter Dodge said recycling organic waste has been done in Europe, where garbage disposal problems are more acute. However, Dodge added IBR's technology puts it ahead of the Europeans.

Dodge explained organic waste is fed into a pulper developed by IBR. The pulper breaks down the organic waste and discards inorganic material, such as staples used on wax cardboard.

The organic waste moves to the 60-ton digester, where wee microorganisms are introduced and chew up organic material. Another batch of bugs then digests the organic matter and eats the first bugs. More bugs eat those bugs as a chain reaction begins. After 48 hours, 6% of the original volume is left in the digester.

That is pumped through a screening process, which allows liquid to pass through and stops everything else. That material continues the digestive process for as long as is required. Items that can't be digested, such as the elastic bands around lettuce, are removed and head for the garbage.

After 72 hours, the majority of digestion process is complete. All pathogens have been killed. A press separates solids from liquids. Solids are dried with a kiln and become fertilizer. Liquids are evaporated to one-sixth concentration and become liquid fertilizer.

Dodge added that the entire system is a closed loop that does not permit emissions, so there is no smell outside the plant.

One of the technological

See Waste page **25**

Recycled waste emission-free

From page **24**

keys to IBR's operation is the proprietary Shearator, which quickly injects high concentrations of oxygen into the digester and accelerates the digestion process. With the Shearator, the company's digestion process takes place at hotter temperatures and is 4.5 times faster than the competition.

The Shearator can also be used in pulp and sludge treatment lagoons, and municipal waste treatment, said Dodge.

IBR's plant has been in operation since Nov. 15, 1993. Since then, IBR, with help from the University of British Columbia, the National Research Council and the B.C. Research Institute have developed the equipment through a lot of trial and error, said Dodge.

IBR's 26,000-square-foot plant just east of the Second Narrows Bridge currently transforms 60 metric tonnes of organic waste into organic fertilizer per week.

The plant is being closed for four months to allow the company to upgrade production to 50 metric tonnes a day by December.

IBR intends to add more digesters so it is able to handle 130 metric tonnes a day, but that will depend on organic waste coming in on a steady stream. That's where the company's vision of a blue box program for biodegradable waste similar to that for newspapers and glass comes in.

The company is in the process of going public to raise $3 million.