

# BIO-WASTE COMPOSTING FACILITY AT THE WASTE AUTHORITY OF S.O.W., HOORN/ NETHERLANDS

T. SCHÜTTE, B. GÖGEL, AND U. MAIRE

Buhler Inc.

Minneapolis, Minnesota

## INTRODUCTION

### Wastes Processed

Bio-wastes are predominantly those wastes which are disposed of in the kitchen and are collected separately from the rest of the garbage. (In Europe, garbage disposals are generally not used.) Vegetative waste components may be included.

In Europe, these wastes amount to about 20–45% of household garbage. Depending on the local situation, this is approximately 35–100 kg bio-waste per person per year. These wastes are rather homogeneous and occur evenly throughout the year. Bio-wastes generally have a high moisture content of about 50–70%.

The result of this high moisture content is a relatively compact mass for composting which is difficult to aerate unless bulking material is used. For this reason the coprocessing of yardwaste is necessary to achieve proper structure in the compost. Current knowledge indicates that the bulking material content should be about 25–30% by volume.

Yardwastes are wastes (such as brush, branches, leaves, grass, etc.) which occur in public parks and gardens. These wastes occur in varying amounts and different composition, structure and bulk density over the different seasons.

Seasonal tendencies in material characteristics:

(a) Spring: Medium quantity, relatively dry, lots of structural material.

(b) Summer: High quantity, sometimes very wet, little structural material.

(c) Fall: Very high quantity, relatively dry, lots of leaves and structural material.

(d) Winter: Very small quantity, only structural material (if collection even occurs).

The peak amount in the fall (October/November) amounts to about 2 to 2.5 times the yearly average.

The quantity of yardwaste is about 20–50 kg per person per year.

In order to achieve a uniform “mix” for composting throughout the year, it is beneficial to prepare and store the large quantities of structural material occurring in the fall. Portions of this material can be added to the structurally poor summer material.

### Collection Method in the Area of the Waste Authority

Like other European countries, among them Germany and Switzerland, the Netherlands decided to dispose of kitchen and yardwastes separately. This represents the enormous amount of over one million metric tons per year. It was recognized that the separate collection of bio-wastes for composting is a suitable way of returning a waste material to nature.

Most communities and cities in Holland collect garbage in 120-L containers. The waste authority S.O.W. has collection experience with a two container system

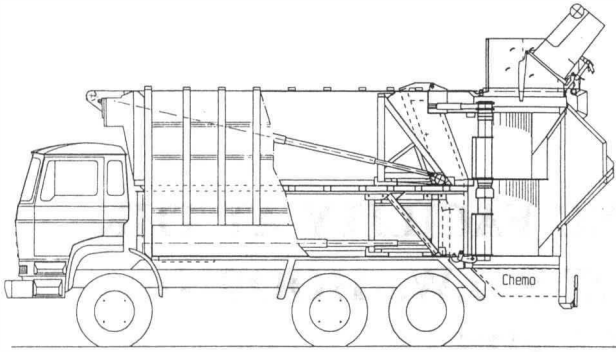


FIGURE 1

for over 2 years: a green container for bio-waste and a black one for the rest of the garbage. Collection is every 2 weeks. Both containers are emptied simultaneously into separate compartments of a special collection truck. This compactor truck is separated horizontally into two compartments. The lower compartment contains the bio-waste while the residential garbage is held in the upper compartment. Figure 1 shows a cross section of the collection truck. With the phase I construction of the composting plant, about 75,000 homes are served with this method. In about 1 year the second phase will be built doubling the capacity to 150,000 homes.

Through good information and motivation of the citizens, a participation of 95% was achieved. The amount of contaminants at 2–3% in the bio-waste is considered very good. As previously mentioned, about 40% of the total garbage is bio-waste and is collected separately. This amounts to 100 kg per person per year.

Recyclable materials are separated at home and collected in various ways. In most cities, paper and glass are brought to drop-off sites in neighborhoods. Commercial services collect these materials at institutions and offices. For plastic containers, a recycling system is being developed.

Costs were not the least of all reasons that the waste authority decided to take a leadership role in the separate collection and composting of kitchen and yard-waste.

The high degree of automation in the composting plant described below, which can be operated with a minimum of personnel, resulted in very attractive operating costs of approximately \$40/metric ton of waste. (As a comparison an incinerator plant has operating costs of about \$100/ton.)

Another advantage of this environmentally sound disposal method is a high quality product. This means the production of mature, i.e., fully plant compatible,

ANALYSIS OF COMPOST FROM WESTFRIESLAND (HOLLAND)			
<u>Heavy Metals</u> (parts per million)			
	Limits (Dutch Standards)		Westfriesland
	1992-1994	from 1995	Compost (actual)
Copper	300	60	36
Zinc	250	240	175
Cadmium	2	1	0.5
Chromium	200	60	11
Nickel	50	30	10
Lead	200	180	96
Mercury	2	0.7	0
<u>Chemical Analysis</u> (%)			
Organic matter content			55.5
Nitrogen			1.92
Phosphorus			1.26
Magnesium			0.43
Calcium			3.96
Potassium			1.32
C/N ratio			13:1

FIG. 2 ANALYSIS OF COMPOST FROM WESTFRIESLAND (Netherlands)

compost (maturity degree V according to German standards) with very low levels of heavy metals (see Fig. 2).

### TECHNICAL DATA OF COMPOSTING PLANT

The Waste Authority S.O.W. Hoorn entered into a contract with Buhler for a central composting facility (Fig. 3) for kitchen and yardwaste. The plant was commissioned in December 1990.

Capacity: 29,400 metric ton/year (Phase I)

58,800 metric ton/year (Phase II)

Processed Material: Bio-waste (kitchen and vegetative waste);

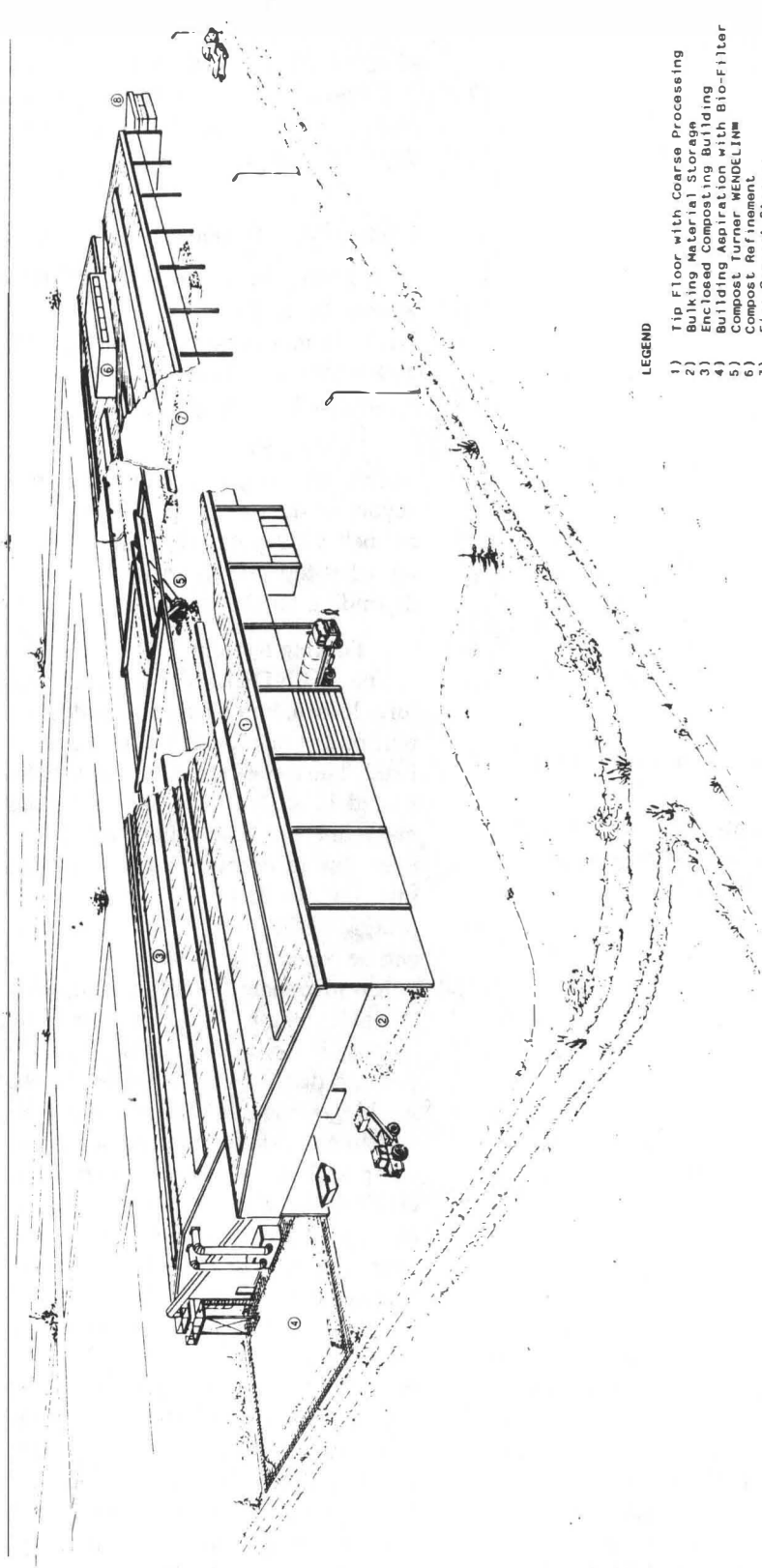
Yardwaste (brush and tree cuttings)

Processing Method: Static/dynamic Buhler composting process with forced aeration and WENDELIN™<sup>1</sup> composting system with fully automatic pile forming operation.

### FACILITY DESCRIPTION

Most modern composting facilities consist principally of 3 system components. They are:

<sup>1</sup>Buhler Worldwide Trademark.



LEGEND

- 1) Tip Floor with Coarse Processing
- 2) Bulking Material Storage
- 3) Enclosed Composting Building
- 4) Building Aspiration with Bio-Filter
- 5) Compost Turner WENDELIN
- 6) Compost Refinement
- 7) Fine Compost Storage
- 8) Administrative Office with Laboratory

FIG. 3 BIO-WASTE COMPOSTING FACILITY MEEMEBLIK  
(S.O.W. Hoorn, Netherlands)

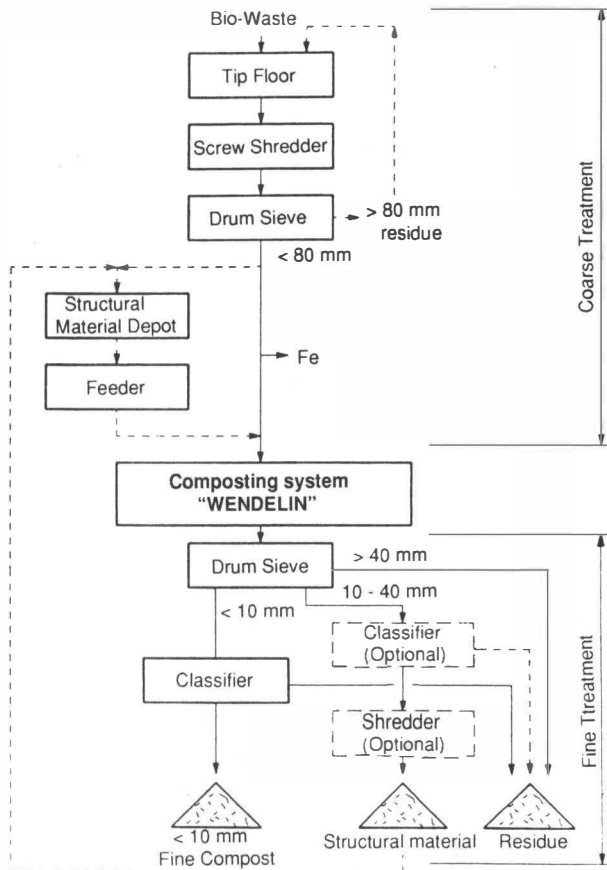


FIG. 4 PROCESS FLOW CHART FOR MEDEMBLIK COMPOSTING PLANT (S.O.W. Hoorn, Netherlands)

- (a) Coarse processing.
- (b) High rate decomposition (and curing).
- (c) Compost refinement.

With the help of the process flow chart of the Medemblik composting plant (Fig. 4), coarse processing, composting and compost refinement are discussed below.

### Coarse Processing

The coarse processing system consists of the following elements: tip floor acceptance area, shredder, trommel screen, intermediate depot and feeder for bulking material.

The most important element for the coarse processing system is the shredder. Shredding of the enormous range of bulk densities of the waste, e.g., leaves, grass, shrubby cuttings, large branches, etc. is a complex task. The Triple-Screw Shredder TRIMALIN™<sup>1</sup>

was developed specifically for this application. The advantages of this machine are: low screw speeds, large inlet opening, self-feeding, not sensitive to obstructions, selective shredding (plastic bags are left in large pieces).

If materials low in structural content are processed, bulking material can be fed in from the intermediate depot by means of a feeder.

### Composting Technology

#### Operating Principle of the WENDELIN™ System (Figs. 5 and 6)

The composting area can be completely enclosed with odor control and equipped with a fully automatic feeding and discharging system.

#### Feeding System

The raw compost is transferred to the two belt conveyors on the feeder bridge by means of two longitudinal belt conveyors. The traveling feeder bridge builds up a flat-top pile to an optimal height of up to 3 m depending on the product.

#### Turning System

The WENDELIN™ turning machine is used to turn, loosen, homogenize and add moisture to the compost on the one hand, and to reposition it on the other hand. The repositioning of the new flat-top pile is controlled in such a way that the height of the pile is maintained, i.e., the reduction in volume of the compost mass due to decomposition is automatically compensated for. In this manner, the area required for composting during, e.g., 10–12 weeks' decomposition time, can be reduced by 22%.

A bridge spans the composting area and travels along its entire length like an overhead crane. A transverse carriage is mounted onto this bridge. The bucket wheels and the discharge belt of the WENDELIN™ turner are hinge-mounted onto the carriage.

While the slowly turning bucket wheels pick up the compost from the bottom, the transverse carriage travels along the width of the area. As soon as the transverse carriage stops at the lateral edge, the bridge is moved approximately 20 cm into the pile to be turned. The carriage then moves in the opposite direction towards the opposite edge. By this procedure, an approximately 20-cm thick section of the 2.5–3.0-m high pile is removed. The product is loosened and homogenized. Depending on the turning capacity as well as on the moisture content of the product, an appropriate amount of water is added. In this manner, the WENDELIN™ turning machine traverses the entire length of the pile from the composted final product up to the raw compost. The bucket wheels and the discharge belt are then



FIG. 5(a) TIP FLOOR WITH TRIMALIN™ SHREDDER AND BELT CONVEYOR TO SCREENING DRUM

lifted and moved back to their starting positions across the turned pile.

The length of the pile is divided into several sectors and is pressure aerated. In compliance with regulatory toxic limits, CO<sub>2</sub> is removed and the composting hangar is maintained under a slight negative pressure. The exhaust air is deodorized in a bio-filter.

#### **Discharge System**

The WENDELIN™ turner is also used for removing the final product. The final pile is picked up by the

WENDELIN™ turner and transferred to the refinement area by a stationary belt conveyor located transverse to the hangar.

#### **Requirements for the WENDELIN™ Turner System**

In selecting a high rate decomposition system a variety of aspects must be considered:

(a) Pay attention to all the important parameters to reach and maintain optimum composting conditions and therefore maximum rate of decomposition.



FIG. 5(b) WENDELIN™ TURNER IN COMPOSTING BUILDING

(b) Chemical balance in the composting mass (cannot be influenced by the composting process).

(c) Moisture content throughout the composting process.

(d) Provision of oxygen.

(e) Temperature and temperature control.

(f) Particle size of the compost mass.

(g) Capital and operating costs of the whole composting system (equipment and building).

(h) Environmental compatibility regarding odor, noise and dust emissions.

Based on the above considerations, the following specifications result for the system:

(a) No odor emissions, i.e., a completely closed system for the whole duration of the composting process.

(b) Minimum leachate.

(c) High degree of decomposition for finished compost, i.e., degrees IV or V according to the German Standards.

(d) High degree of automation.

(e) Low energy consumption.

(f) Low equipment wear.

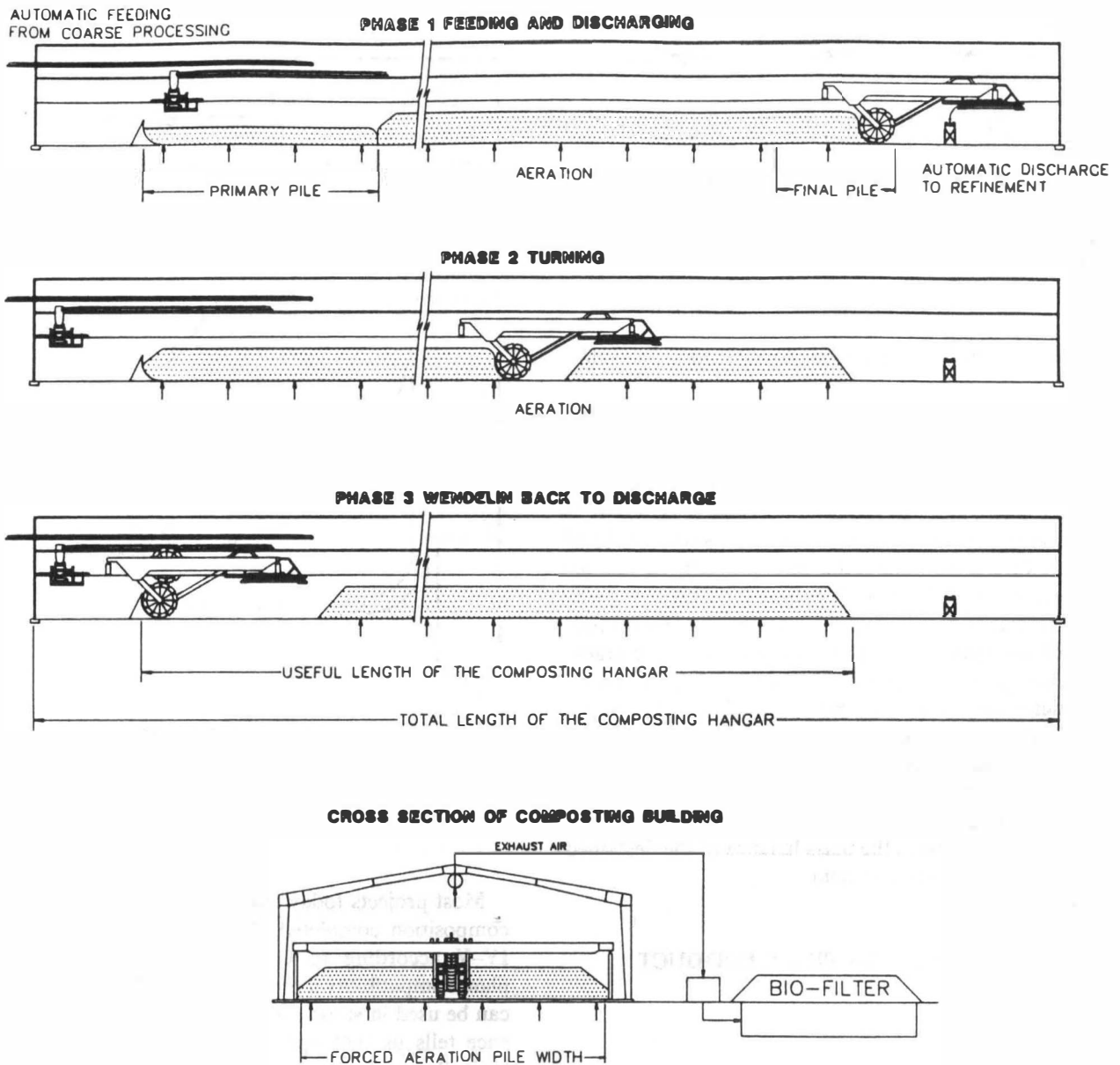


FIG. 6 OPERATING PRINCIPLE OF WENDELIN™ SYSTEM

(g) High specific compost per area loading.

These requirements lead to a closed, aerobic composting system with fully automatic feed, turning, water addition, aeration and discharge system.

The WENDELIN™ system fulfills these requirements.

#### Aeration for the Composting System

The aeration floor under the flat top pile is divided into several sections along the length of the pile. The aeration occurs via positive pressure fans. The compost-

ing building is aspirated to maintain acceptable levels of CO<sub>2</sub> and maintained under a slight negative pressure. The exhaust air is passed through a bio-filter to remove odor.

A bed of pebbles of uniform particle size can be used as the aeration floor. Aeration pipes are laid into the floor and the floor is then protected from fine compost particle contamination by a layer of wood chips.

#### Time Sequence of the Composting System

Figure 7 shows the process time sequence of the composting system.

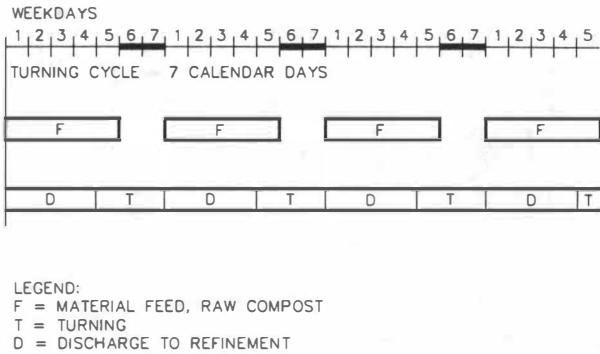


FIG. 7 TIME SEQUENCE OF WENDELIN™ SYSTEM

### Compost Refinement System

The purpose of the compost refinement system is to separate foreign materials from the coarse compost and to produce a marketable finished product. A possible arrangement is shown in Fig. 8.

The coarse compost is fed into the trommel screen which separates it into three fractions, i.e., fine grade, medium grade and residue. The fine fraction containing particles less than ca.10 mm yields the final product, finished compost. Any remaining contaminants in the fine compost are removed in a special classifier. The medium fraction is either reused as structural material or as a mulch.

Figure 8 describes the mass balance of the described bio-waste composting system.

### MASS BALANCE AND FINAL PRODUCT QUALITY

#### Quality

For very good reasons a great deal of importance is attached to compost quality, since a composting plant can only be justified if a marketable compost can be produced. Several trade and professional associations are currently in the process of creating compost quality standards, the Solid Waste Composting Council among them. Quality criteria are typically divided into the following items:

- Disinfection (pathogen kill).
- Degree of decomposition (maturity).
- Plant compatibility.
- Contaminants.
- Other characteristics.

The most important quality criteria which are influenced by the composting system are maturity and plant compatibility.

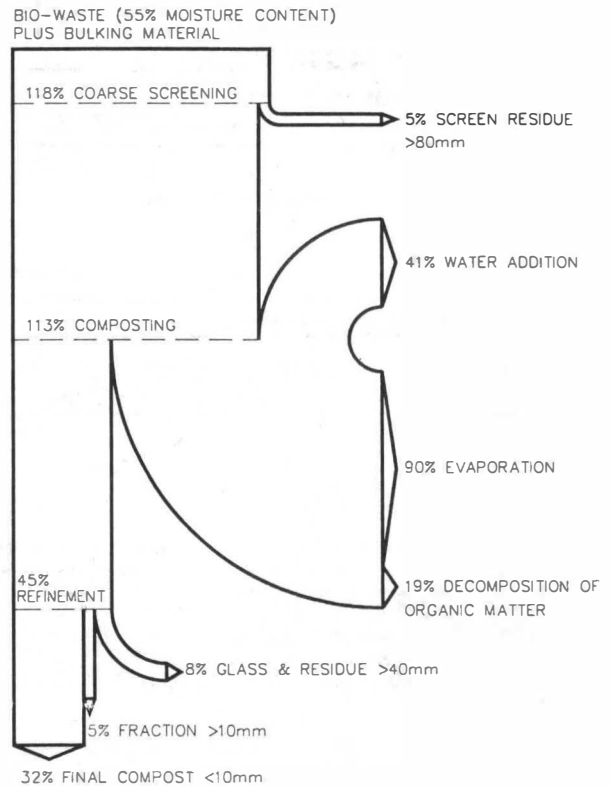


FIG. 8 MASS BALANCE  
(Metric Tons per Day)

Most projects today require a compost with the decomposition completed, this means a maturity grade IV-V according to German Standards. Regarding plant compatibility a product is typically desired which can be used in substrates at a rate of 30-60%. Experience tells us that optimum decomposition processes typically reach this result after about 10-12 weeks of composting.

#### Final Product Quality

In 11 weeks of decomposition time a compost of the following quality is produced:

- Particle size of < 10 mm.
- Free of contaminants.
- Degree of decomposition V (highest degree for finished compost).
- Low in heavy metals (the most stringent standards currently in force can be complied with).

Composts with such a quality have a wide application range.



## SUMMARY

The compost turner WENDELIN™ turns the material, adds moisture, compensates the volume reduction due to decomposition and transports the mature compost to the refinement system at the end of the process.

This results in the following main advantages for this compost system:

(a) Maximum space utilization, depending on type of waste up to  $3 \text{ m}^3/\text{m}^2$  (1.5 ton/sq yd) via:

(1) Pile height of 10 ft.

(2) Compensation of volume reduction.

(b) Virtually no odor emissions: completely enclosed system.

(c) Mature compost within 10–12 weeks: optimum rate of decomposition.

(d) Fully automatic turning system: low costs due to low personnel requirements.