ORBIT 2006

Biological Waste Management ››› From Local to Global

5th International Conference ››› 13th to 15th of Sept. 2006 in Weimar, Germany

ANALYSIS OF THE RESULTS OF THREE YEARS OF OPERATIONS AT THE MASSAFRA, ITALY MBT PLANT

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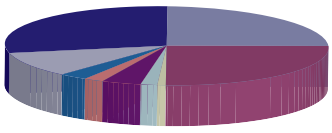
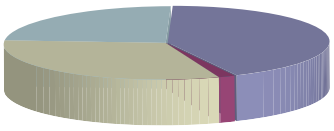
The Massafra MBT plant, operated by CISA SpA, produces biodried RDF from residual municipal waste. The Italian legislation defines the specifications of RDF, which qualifies for use at off-site thermal treatment facilities. The drying of RDF is fuelled by the biological heat generated in ECOMASTER biotunnels through a controlled composting process. No external source of heat is necessary to produce RDF having the maximum moisture content specified by the Italian rules. All the RDF produced is used by a nearby power station for generation of electric energy. In the operational year 2005 the plant processed 72,618 tonnes of mixed municipal waste with a landfill diversion rate of 66.13%.

COMPOSITION OF PROCESSED WASTE



PAPER	24.20 %
PLASTICS	25.94 %
TEXTILES	0.76 %
WOOD	1.68 %
GLASS	3.85 %
METALS	2.07 %
INERTS	2.66 %
ORGANIC	10.00 %
FINES	28.84 %

MASS BALANCE OF PROCESS



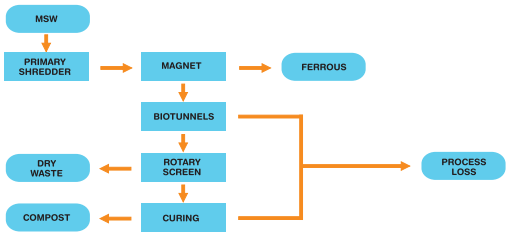
RDF	42.47 %
FERROUS	1.68 %
REJECTS	32.19 %
PROCESS LOSS	23.66 %

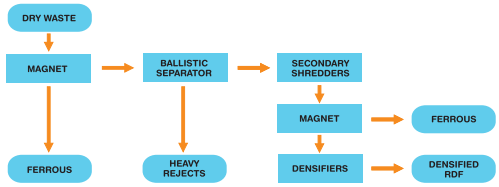
SPECIFIC REQUIREMENTS PER TONNE OF WASTE PROCESSED

STAFFING 0.29 hr

ELECTRICITY 55 kWh

DIESEL FUEL 0.83 LITRES





Analysis of the results of three years of operations at the Massafra, Italy MBT plant

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SUMMARY: The Massafra MBT plant produces biodried RDF from residual municipal waste. The Italian legislation defines the specifications of RDF, which qualifies for use at off-site thermal treatment facilities. The drying of RDF is fuelled by the biological heat generated in nine Ecomaster biotunnels through a controlled composting process. No external source of heat is necessary to produce RDF having the maximum moisture content specified by the Italian rules. All the RDF produced is used by a nearby power station for generation of electric energy. The operational results, such as material balance of the process, tonnages and composition of treated waste, are discussed herein. The Massafra MBT plant allows to recover energy from waste organic material, which would otherwise be disposed in a landfill, thus making a substantial contribution to saving the biomass resource.

MBT, Biodrying, RDF

1 Introduction

The Massafra MBT plant is part of an integrated waste recovery system based substantially on the concept of satellite MBT plants producing biodried RDF to be used for power generation in a centralized RDF-to-Energy plant. This strategic concept is based on the environmental benefit offered by the combustion of a homogeneous fuel derived from the mechanical and biological treatment of the residual waste fraction.

The tradition of mechanical-biological waste treatment is very strong in Italy, which is the top ranked European country from the point of view of overall treatment capacity (Steiner, 2005). However, it should be noted that various MBT projects have not been very successful due to both technical problems - often odour emissions - and the lack of RDF utilizations.

The Massafra MBT plant, completed at the end of 2003, has already cumulated almost three years of successful operations and all the RDF produced has been recovered for power generation at the Appia Energy power station. The project confirms the validity of the regional waste disposal plan and shows that the mixed reputation of Southern Italy in solid waste disposal can be reversed by the success story of this model MBT plant that has already attracted the interest of many international visitors.

2 Legislative Framework

The Seveso environmental disaster of 1976, which was due to a gas leak from a chemical facility, made Italians aware of dioxins the hard way. At that time, many incinerators were operating without an adequate air pollution control system and waste incineration was associated with the dioxins found in the air emissions and, consequently, with "disaster". The following debate comparing RDF combustion versus mass burning has shown that there are believers on both sides and it is not the purpose of this paper to contribute to the discussion. However, in Italy the belief that the environmental impact of RDF combustion is better due to the higher heating value and more homogeneous composition of RDF is certainly prevalent (Mininni, 2001). This concept is reflected in the "Decreto Ronchi", a comprehensive law regulating solid waste issued in 1997 in compliance with various directives of the European Union. This law introduced a special status for "CDR - Combustibile da Rifiuti" , i.e. RDF meeting well defined minimum quality specifications, and allowed CDR production and combustion facilities to have a simplified permitting procedure. In a following ministerial decree (D.M. 05-02-1998) the specifications of CDR were introduced (see Table 1).

Table 1 CDR Specifications

Parameter	Weight Basis	Limit	Value
Heating value	Wet	Min.	15,000 kJ/kg
Moisture	Wet	Max.	25%
Cl	Wet	Max.	0.9%
S	Wet	Max.	0.6%
Ash	Dry	Max.	20%
Volatile Pb	Dry	Max.	200 mg/kg
Cr	Dry	Max.	100 mg/kg
Soluble compounds of Cu	Dry	Max.	300 mg/kg
Mn	Dry	Max.	400 mg/kg
Ni	Dry	Max.	40 mg/kg
As	Dry	Max.	9 mg/kg
Cd + Hg	Dry	Max.	7 mg/kg

The legislation introduced by the "Decreto Ronchi" favoured the success of CDR, which is often the preferred option for the recovery of the residual waste fraction and has found some supporters even among the environmentalists (energy recovery follows material recovery in the hierarchy set out by the law).

The "Commissario Delegato Emergenza Rifiuti" of the Apulia Region issued a decree (N° 296 dated 30-09-2002) which completed the regional solid waste disposal plan and introduced technical criteria for the mechanical-biological treatment of residual (remaining after source separation) municipal waste. Substantially, the decree requires the primary biostabilization of the waste, prior to the separation of the light fraction to be used for the production of CDR. An optional scheme considers the maturation of the screen undersized fraction for the recovery of material to be used as landfill cover material or for land reclamation (closed mines, etc.).

3 Plant Location and History

The Massafra MBT plant is located in the municipal territory of Massafra, a town with a population of 30,000 inhabitants, located in the Province of Taranto at the heel of the "Italian boot".

The plant is owned by the Municipality of Massafra and is operated under a concession scheme by the private company CISA S.p.A., which has financed the construction works.

The plant was already under construction in 2002, when the decree of the "Commissario Delegato per l'Emergenza Ambientale" of the Apulia Region was issued and the construction permit was promptly changed to adopt the process design criteria stated by this decree and applicable to MBT plants.

The Massafra plant was completed at the end of 2003 and, after commissioning and acceptance testing, commercial operation started officially in 2004. Since its completion, nearly three years of successful operations have passed. This paper reports the operational data of 2005, which, on an annual basis, are representative of the full operational period.

The main mechanical-biological processing system was designed and supplied by Ecomaster, which in 2004 became a partner of the international group Atzwanger S.p.A. based in South Tyrol. Ecomaster Atzwanger S.p.A. is today a leader in the design and turn-key construction of MBT plants and Ecomaster's proprietary tunnel composting technology has been used in a dozen waste treatment facilities.

4 Characterization of the Treated Waste

Although the Massafra plant is designed to process mixed waste having a variable composition, it is evident that the nature of the treated waste is of primary importance when the operational data are analyzed. For this reason, comprehensive information on the treated waste is provided in this section.

4.1 Territory Served

The Massafra plant receives municipal waste and similar special waste (non-hazardous) generated by the Taranto One Area, which includes 12 municipalities (see Table 2). The collection of waste and its transportation to the plant gate is performed by other companies, while CISA S.p.A. is responsible for treating the waste, marketing of products and disposing of process rejects.

Table 2 Municipalities of Taranto One Area

Municipality	Population (Census 2001)
Castellaneta	17,428
Crispiano	12,602
Ginosa	22,099
Laterza	14,883
Martina Franca	47,023
Massafra	30,884
Montemesola	4,277
Mottola	16,570
Palagianello	7,480
Palagiano	15,819
Statte	14,502
Taranto	-
Total	203,567

It must be noted that the Municipality of Taranto is served by an incinerator and therefore the Massafra MBT plant has a back-up function and receives municipal waste from Taranto only when the incinerator is not operating for maintenance purposes. For this reason, the population of Taranto has not been included in Table 2.

The average per capita generation of municipal waste in the Apulia Region is around 1 kg per day, thus the total production of the territory served by the Massafra MBT plant is approximately 74,300 tonnes per year. The waste diverted by the source separation programs is still very limited in Apulia, although there is good progress in a few areas. In the Province of Taranto, where the municipalities served by the Massafra MBT plant are located, the waste diverted in 2000 was only 2% (Osservatorio Nazionale sui Rifiuti, 2002), compared with the regional average of 5%, and peaks higher than 60-70% in Northern Italy. The waste diverted in the area served by the Massafra plant is well below the 35% goal set by the "Decreto Ronchi", but we are confident that the recent efforts will lead to substantial improvements in the near future.

Therefore, the Massafra MBT plant is the major landfill diversion tool currently available to the municipalities served by the plant. The flexibility of the Ecomaster process will accommodate the future variations in the waste composition caused by the development of the source separation programs. In fact, part of the biotunnels could be used for composting source separated organic waste instead of biodrying RDF.

4.2 Waste Composition

CISA S.p.A., the plant operator, hires a specialist consulting firm for periodic waste sampling and analysis of the composition of the treated waste. A typical result of the composition analysis, conducted according to the Italian standard UNI 9246, is provided below (see Table 3).

Table 3 Waste Composition

Component	Percent (Wet Weight Basis)
Paper	24.20 %
Plastics	25.94 %
Textiles	0.76 %
Wood	1.68 %
Glass	3.85 %
Metals	2.07 %
Inerts	2.66 %
Organic	10.00 %
Fraction smaller than 20 mm	27.53 %
Evaporation loss	1.31 %
Total	100.00 %

The sample used for the above composition analysis was taken on September 15, 2005 and prepared after separation of the bulky waste components, which amounted to 3.96 % of the original sample and were analysed separately (see Table 4).

Table 4 Bulky Waste Composition

Component	Percent (Wet Weight Basis)
Cardboard	59.90 %
Plastics	13.80 %
Textiles	6.15 %
Wood	14.23 %
Magnetic Metals	1.89 %
Inerts	1.96 %
Others	2.07 %
Total	100.00 %

It is interesting to note that the content of paper and plastic in the waste is considerably high, which allows for a significant yield of RDF. The presence of food waste is less than might be anticipated for the Summer period, this probably means that the modern packaging procedures have changed the waste composition in Southern Italy as well. Anyway, the quantity of organic waste is still more than adequate for a proper development of the biological drying process.

5 Description of the MBT Plant

5.1 Plant Specifications

The specifications of the MBT plant are provided below (see Table 5).

Table 5 Plant Specifications

Parameter	Value
Permitted capacity	110,000 tonnes/year
Operating days	312 days/year
Daily capacity	350 tonnes/day
Operating hours (mechanical system)	12 hours/day
Throughput capacity	30 tonnes/hour

5.2 Process Design

After primary shredding and ferrous separation, waste is transferred to the biological stabilization process, which takes place in nine composting tunnels. The biological process, which includes stabilization and drying, requires 7 to 14 days, depending on the quality of waste. Exhaust air is sent to a centralized biofilter to control odours.

As shown in the process diagram (see Figure 1), the material is screened after composting and the undersized fraction can be cured in an aerated static pile. The maturation part of the plant is not being used because up to now it has not been possible to find a destination for the compost, which should be used only as landfill cover material or for land reclamation. For these reasons there are plans to build four additional biotunnels in the maturation area to expand the overall plant capacity and flexibility.

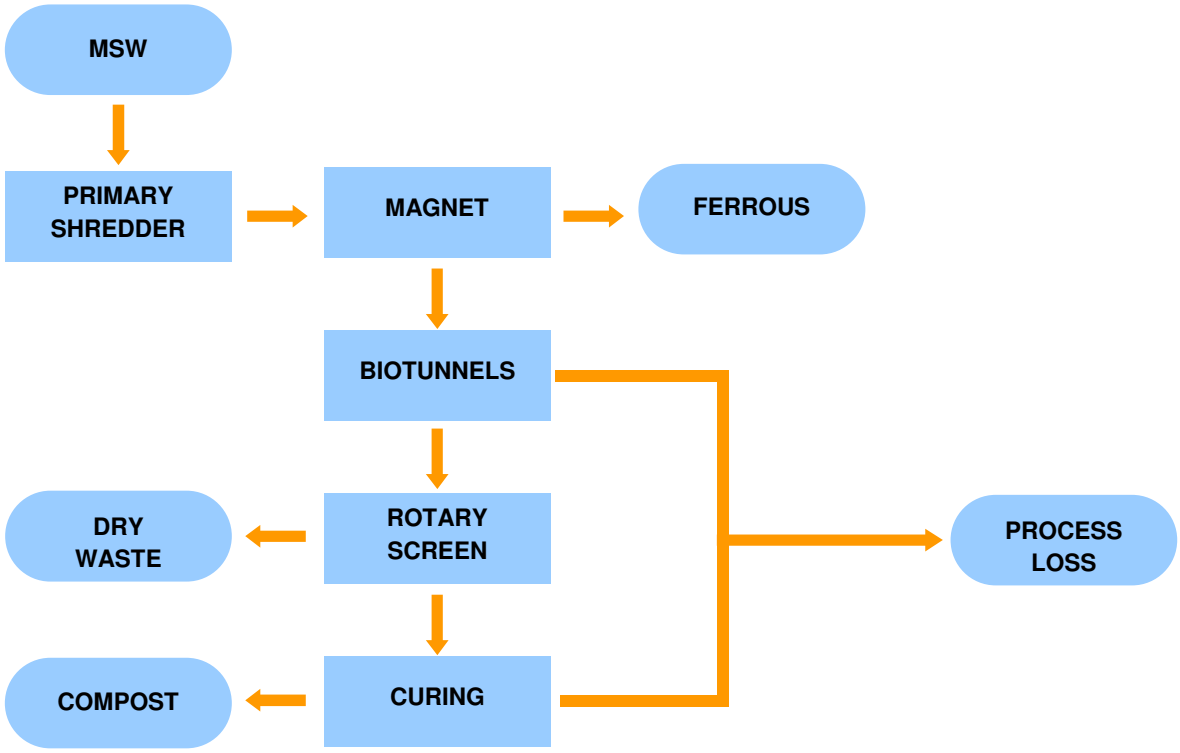

Figure 1 Biological Process Diagram

The biodried screen oversized fraction is processed to convert it into densified RDF (CDR). After ferrous separation, a ballistic separator separates heavy components from the light fraction, which is treated by two secondary shredders. Another magnetic separator attracts further ferrous material, before RDF is processed by two densifiers (see Figure 2).

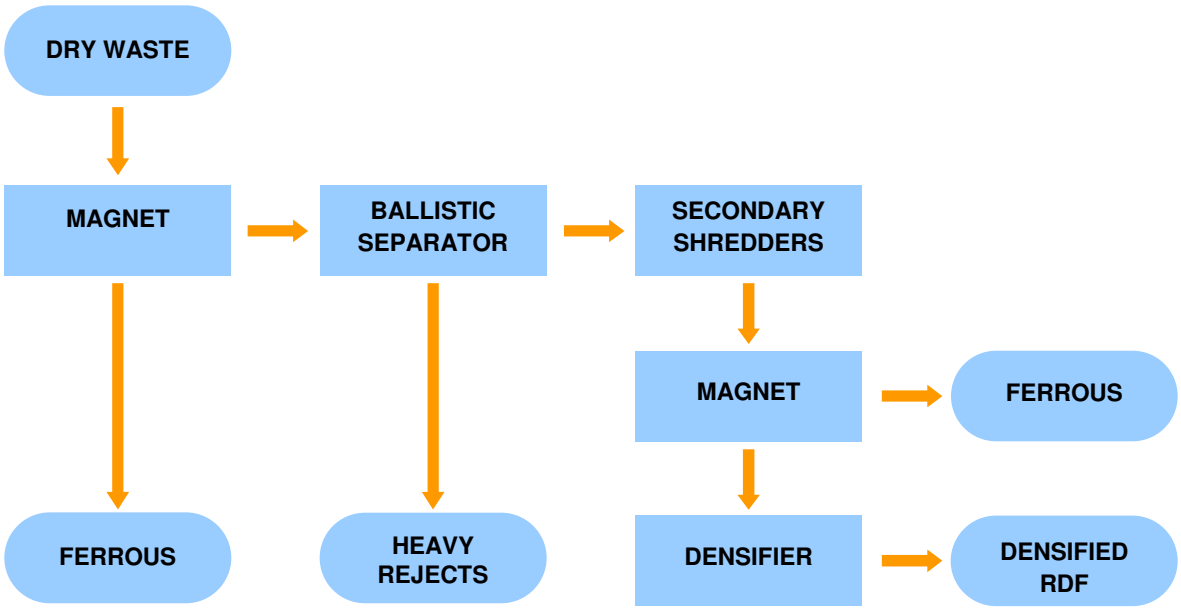

Figure 2 Mechanical Process Diagram

6 Operation Analysis

6.1 Material Balance

The material balance relative to the 2005 operations is reported in Table 6.

Table 6 Material Balance

Fraction	Tonnes	Percent
Non processible waste	278	0.38%
Ferrous metals	1,219	1.68%
Screen undersized fraction	17,012	23.43%
Ballistic separation rejects	6,089	8.38%
Densified RDF	30,838	42.47%
Process loss	17,182	23.66%
Total waste received	72,618	100.00%

6.2 Product Characterization

The RDF produced by the Massafra MBT plant is periodically monitored to verify that the legal requirements applicable to this product are met. The results of testing conducted on three RDF samples are shown in Table 7.

Table 7 RDF Analysis

Parameter	Sample 15-01-05	Sample 06-07-05	Sample 15-12-05	Limit	Value
Heating Value	4,180	4,550	4,080	Min.	3,600 kcal/kg
Moisture	20.0	15.5	18.0	Max.	25%
Cl	0.35	0.51	0.50	Max.	0.9%
S	0.01	0.15	0.35	Max.	0.6%

Ash	18.2	16.0	17.5	Max.	20%
Volatile Pb	53	95	111	Max.	200 mg/kg
Cr	<0.001	15	10	Max.	100 mg/kg
Soluble compounds of Cu	37	89	155	Max.	300 mg/kg
Mn	<0.002	<0.002	<0.002	Max.	400 mg/kg
Ni	<0.002	<0.002	<0.002	Max.	40 mg/kg
As	<0.001	<0.001	<0.001	Max.	9 mg/kg
Cd + Hg	1.0	<0.001	<0.001	Max.	7 mg/kg

Since the date of plant start-up, the entire RDF production has been transferred to the nearby power station Appia Energy and beneficially used for the generation of electric power in a fluidized bed combustor.

Although the ferrous metal product typically contains 80% of ferrous materials, the marketing of this product has been difficult and this product is currently disposed at a landfill together with the process rejects.

6.3 Landfill Diversion Rate

The landfill diversion rate provided by the Massafra plant in the operating year 2005 is calculated in Table 8.

Table 8 Landfill Diversion Rate

Fraction	Percent	Landfill Disposed
Non processible waste	0.38%	0.38%
Ferrous metals	1.68%	1.68%
Screen undersized fraction	23.43%	23.43%
Ballistic separation rejects	8.38%	8.38%
Densified RDF	42.47%	0.00%
Process loss	23.66%	0.00%
Total waste received	100.00%	33.87%
Landfill diversion rate	66.13%	

The above landfill diversion rate, which does not take into account the ash deriving from RDF, can be improved once a market for ferrous has been found.

6.4 Staffing, Utilities and Fuel Consumption

Table 9 provides the staffing requirements and the consumption of utilities and diesel fuel on an annual basis (reference is made to 2005). The specific requirements indicated in this table relate to one tonne of waste processed by the MBT plant and based on a total of processed waste amounting to 72,618 tonnes. Table 9 was prepared using information extrapolated from the 2005 environmental declaration of CISA S.p.A. which operates according to an environmental management system certified to comply with the Standard UNI EN ISO 14001 and EC 761/2001 EMAS (Eco Management and Audit Scheme).

Table 9 Staffing, Utilities and Fuel Consumption

Item	Requirement	Specific Requirement
Staffing	21,600 hours/year	0,29 hours/t
Electricity	4,000,000 kWh/year	55 kWh/t
Water	16,000 m3/year	0.22 m3/t
Diesel fuel	60,000 l/year	0.83 l/t

References

Steiner (2005): M. Steiner, Status of mechanical-biological treatment of residual waste and utilization of refuse-derived fuels in Europe, Conference "The future of residual waste management in Europe" November 2005, Luxembourg.

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Osservatorio Nazionale sui Rifiuti (2002): Osservatorio Nazionale sui Rifiuti, Rapporto annuale sulla gestione dei riifuti, October 2002.

CISA S.p.A. (2005) Environmental Declaration - Environmental Management System certified according to Standard UNI EN ISO 14001and EC 761/2001 EMAS (Eco Management and Audit Scheme).