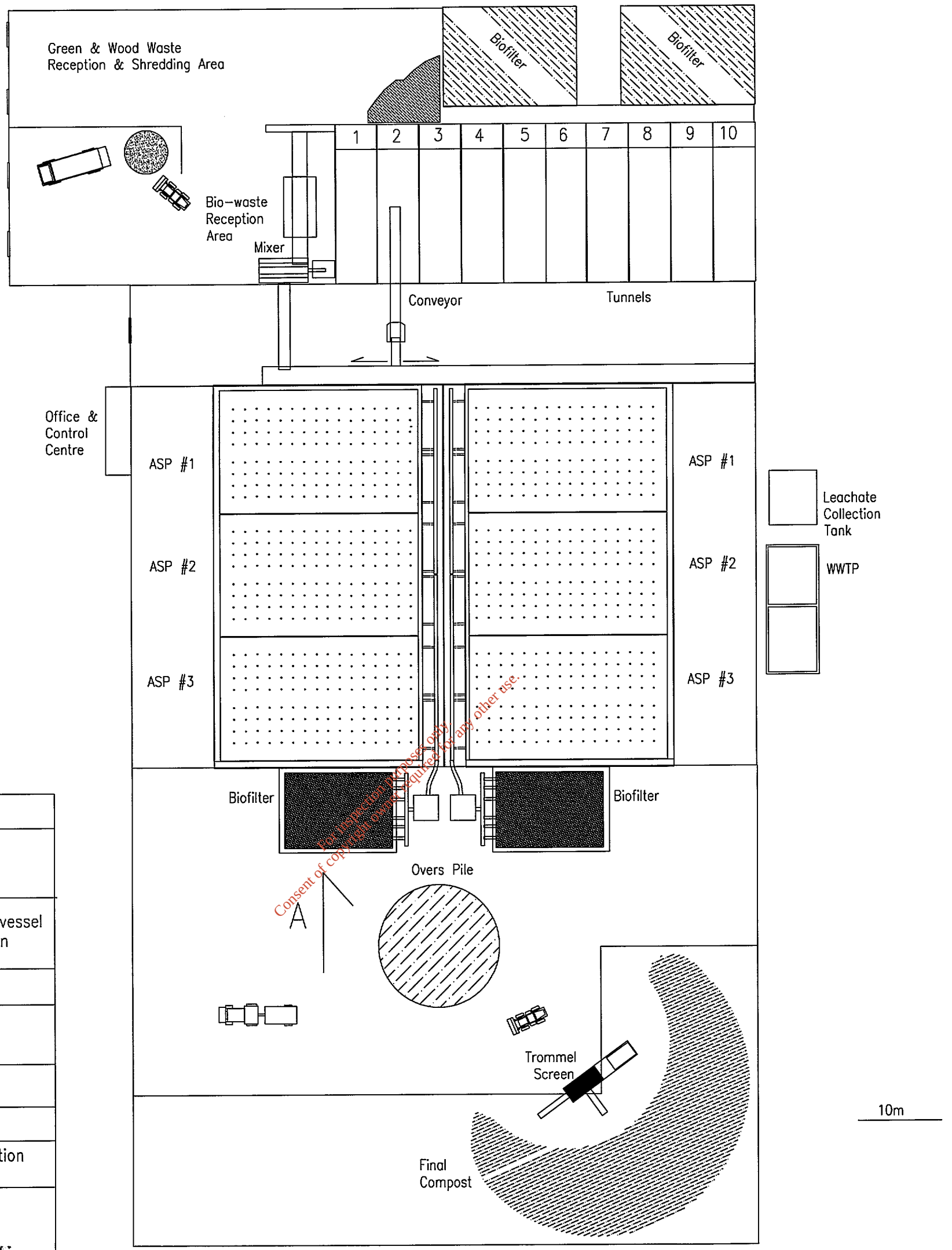
APPENDIX 2

EXAMPLES OF FACILITY LAYOUTS FOR THE BIOLOGICAL TREATMENT FACILITY FOR COMPOSTING & ANAEROBIC DIGESTION

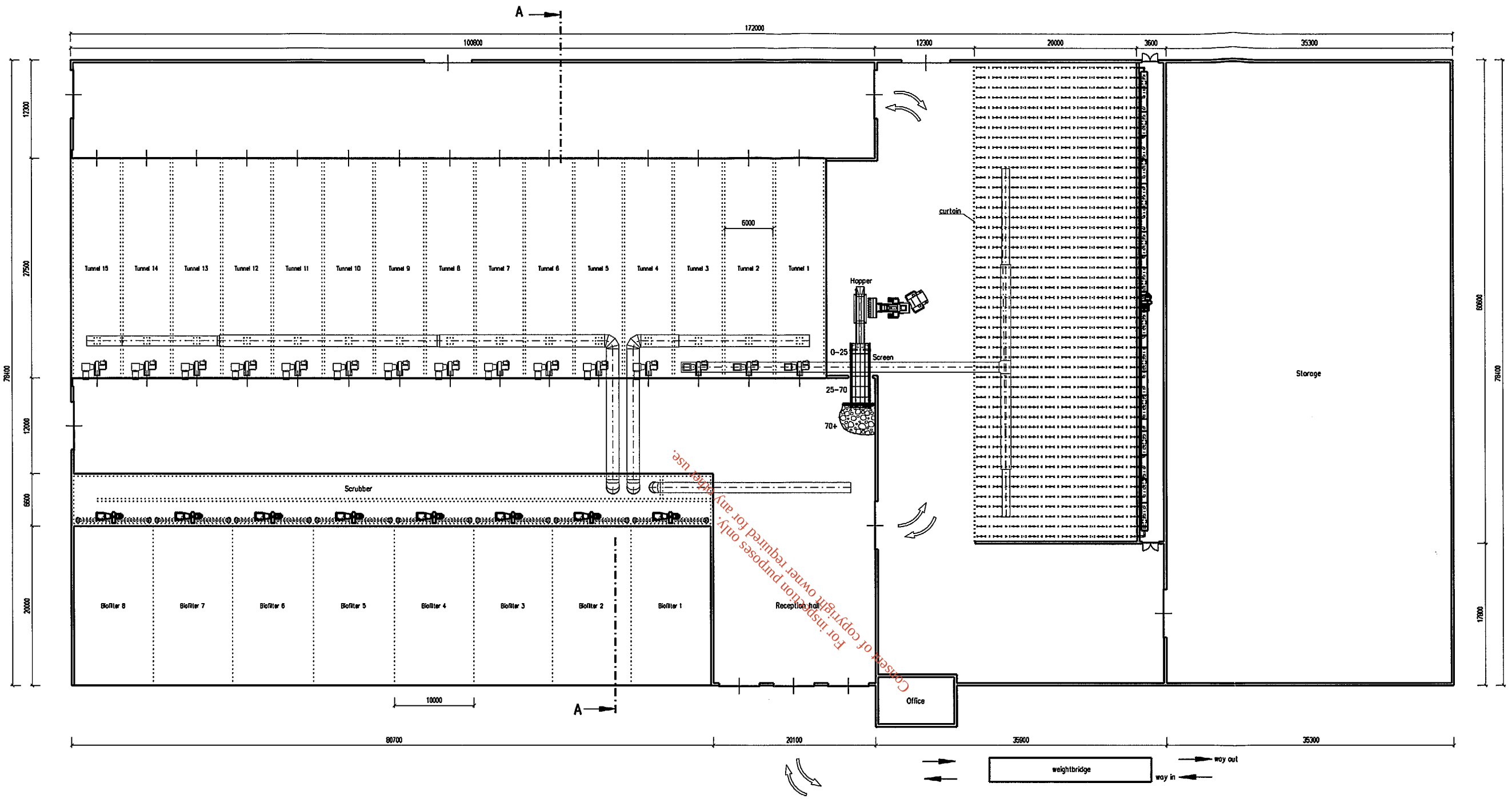
EXAMPLES OF COMPOSTING FACILITIES

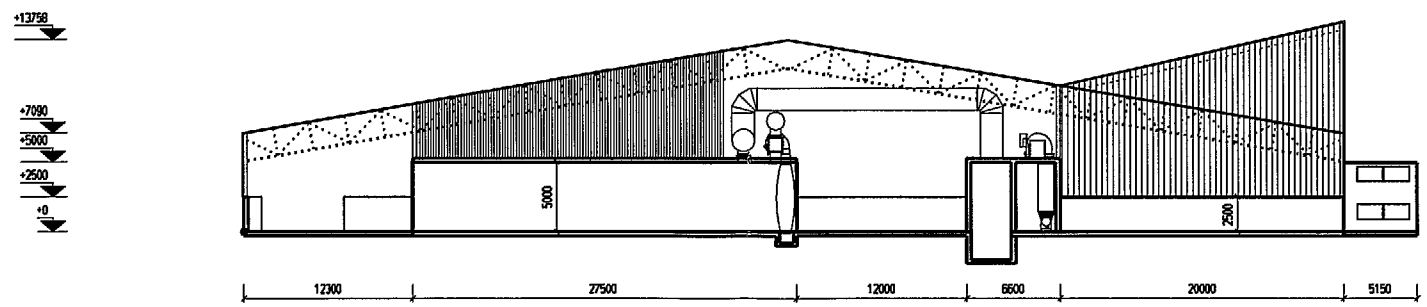


Date: 30.12.03
DRN: ARW CHK:
Project: 30,000 tpa in-vessel compost facility site plan
Client:
Title: Conceptual
Drawing No. CCS136
Scale: 1:500 (A3)
Not for Construction

Celtic Composting Systems Ltd.

45 Corabbey Court
Distillery Walk
Midleton
Co. Cork
Tel: 021 4621721
Fax: 021 4621725
Mob: 086 3872139





Section A-A

GICOM
COMPOSTING SYSTEMS
GICOM B.V.
OOGSTWEG 9
8256 SB BIDDINGHUIZEN
THE NETHERLANDS
TEL 31(0)321-332682
FAX 31(0)321-332784
WWW.GICOM.NL

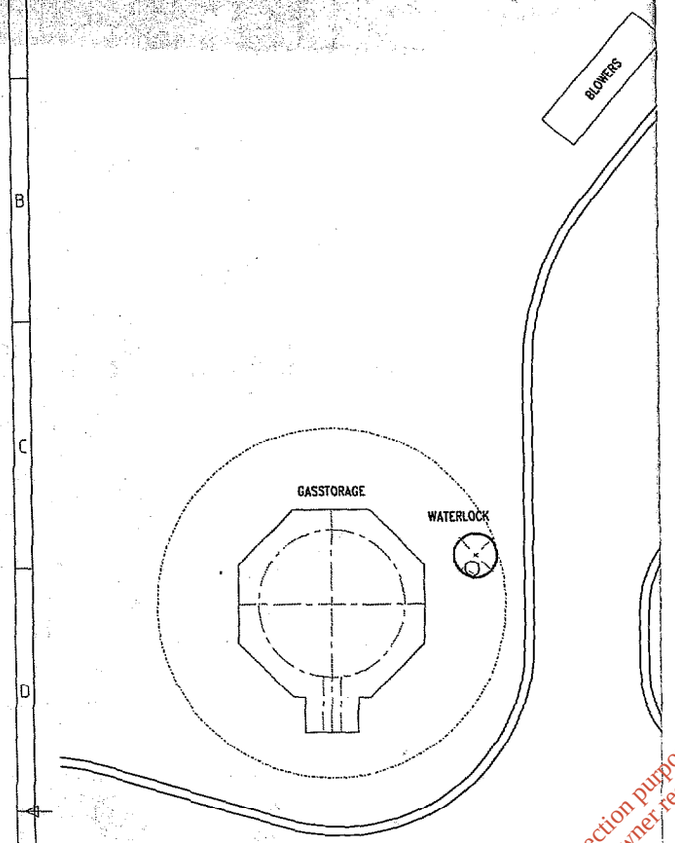
Client: Bally Ogan		Scale: 1:250	Revision: ---
		Format: A1	Release: ---
		Name:	Date: (d.d.mm.yyyy)
Project description: 15 Tunnels + biofilter + aerated floor		Drawn: H.Lv.d.Ven	20-12-2006
		Checked: ----	----
		Rev: ----	----
Subject: Groundplan with airhandling situation 2		Drawing no.: V1-02	Project no.: 2912

Filename: P:\Work_Tekeningen\Bally-Ogan_2912\V1-02-Groundplan.vwx

EXAMPLES OF ANAEROBIC DIGESTION FACILITIES

002

G02



0 m 5 m 10 m 20 m

Related drawings:

General Notes:

Rev.	Description	Date	Drawn	Approved
00		21/12/01	AK	

Date 19/12/2001

Drawn AK

Drawing No.

Status

Scale 1/200

Project No. 1069

Format A1

Checked

O.W.S. n.v.
Dok Noord 4
B-9000 GENT
Tel. : 32/9/233.02.04
Fax : 32/9/233.28.25
E-mail: mail@ows.be
Web site: www.ows.be

Organic Waste Systems

Client: Igean

Project: Brecht 2

Drawing: Dranco installation
Implantation plan

OWS
Organic Waste Systems

The DRANCO technology

Organic Waste Systems

ORGANIC WASTE SYSTEMS

Organic Waste Systems (O.W.S.) is a stock company under Belgian law, constituted in 1988 with a capital of 1,2 million EURO, and specialised in biological treatment of solid and semi-solid wastes. O.W.S. has 35 employees and an annual turn-over of about 5 million EURO.

O.W.S. developed the patented DRANCO process. The DRANCO process converts solid and semi-solid organic waste into renewable energy, biogas and a stable humus-like end product, Humotex. The conversion takes place in closed fermenters under anaerobic conditions, the biogas is collected and used as energy source. O.W.S. has constructed several DRANCO plants in Austria, Belgium, Germany, Japan and Switzerland.

O.W.S. also offers consulting and laboratory testing services. Consulting services are offered to various clients from the public and private sector in the field of biodegradation and compostability, waste separation, recycling, integrated waste management and related legislation in both Europe and the U.S. O.W.S. also provides laboratory testing services for the determination of biodegradability and compostability of plastics, packaging materials, consumer products, detergents, etc. under strict quality conditions. The laboratory has been officially recognised to work under GLP (Good Laboratory Practices).

OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825

Organic Waste Systems

THE DRANCO TECHNOLOGY

The DRANCO process

The DRANCO process is an advanced biotechnology for an environmentally friendly and cost-effective treatment of organic waste. The DRANCO process consists of a thermophilic, one-phase anaerobic fermentation step, which is followed by a short aerobic maturation phase. During the anaerobic digestion phase, the organic material is converted into biogas. This process takes place in an enclosed digester. The total solids content in the digester depends on the input material. The flexibility of the DRANCO technology allows the treatment of a wide range of different input materials. The digested residue is extracted from the digester, dewatered and then stabilised aerobically during a period of approximately two weeks. The aerobic maturation ensures complete stabilisation of the material, which can not degrade any further under anaerobic conditions. The final product is called Humotex and is a very hygienically safe and stabilised soil amendment.

The DRANCO feedstocks

The DRANCO technology can be used for various types of organic waste streams :

- biowaste and other source-separated organic waste streams
- the organic fraction of mixed waste obtained through mechanical separation
- dewatered sewage sludge
- other organic waste streams, including non-recyclable paper, market waste, industrial waste etc...

The DRANCO process parameters

- Digester loading : 10 to 20 kg COD/$m^3_{reactor}$-day
- Temperature range : 50 to 58°C
- Retention time in the digester : 15 to 30 days
- Biogas production : 100 to 200 m^3 of biogas per ton of waste
- Electricity production : 170 to 350 kWh per ton of waste

OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825

The DRANCO advantages

- The DRANCO process is a **one-step process**. The complete anaerobic process takes place in the same digester volume. This results in a simple operation of the process and increases the reliability of the installation because it is less complex then a multi-step system.
- The DRANCO process occurs at **thermophilic operating conditions (50-55°C)**. Tests have proven that the biogas production, and the related energy production, is higher than obtained by mesophilic temperatures (30-35°C). This high temperature, which is the same in the complete digester and throughout the process, leads also to a kill off of the pathogens and weed seeds in the material.
- The fresh material is intensively mixed with inoculum before it is brought into the digester. This **patented external mixing system** makes a good controlling of the mixing possible. Therefore it is not necessary to mix the substrate in the reactor itself. There are no mechanical parts inside the reactor. This stationary aspect makes the **digester design simple and reliable**. The high mixing ratio of residue with fresh material leads to a quick biodegradation of the waste with high degradability.
- The DRANCO process allows **big fluctuations** in the dry matter content **of the input material.** During the DRANCO process the total solids content spontaneaously adjusts to the input material.

The DRANCO References

Demonstration plants

City, year	Country	Capacity	Type of waste
Ghent, 1984	Belgium	60 m³	Mixed waste / biowaste
Bogor, 1986	Indonesia	30 m³	Market waste
Florida, 1989	USA	1 m³	Mixed waste
Graz, 1990	Austria	5 m³	Mixed waste
Kagoshima, 1998	Japan	30 m³	Manure / organic waste
Yaku, 2001	Japan	30 m³	Manure / organic waste

Full-scale plants

City, year	Country	Capacity	Type of waste
Brecht I, 1992	Belgium	20,000 t/y	Biowaste / waste paper
Salzburg, 1993	Austria	20,000 t/y	Biowaste
Bassum, 1997	Germany	13,500 t/y	Grey waste
Aarberg 1998	Switzerland	11,000 t/y	Biowaste
Kaiserslautern, 1999	Germany	20,000 t/y	Grey waste
Villeneuve, 1999	Switzerland	10,000 t/y	Biowaste
Brecht II, 2000	Belgium	50,000 t/y	Biowaste / waste paper
Alicante, 2003	Spain	30,000 t/y	Mixed waste
Rome, 2003	Italy	40,000 t/y	Mixed waste

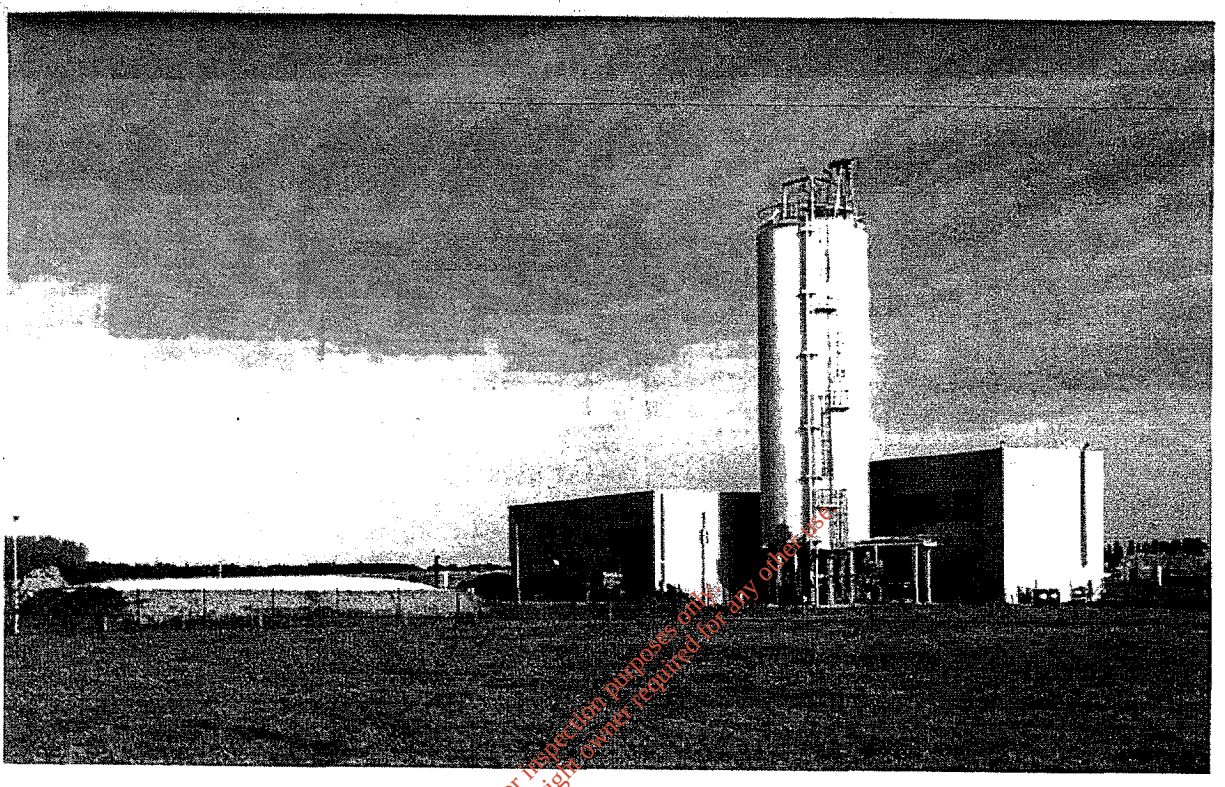
OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825

002

G02

OWS
Organic Waste Systems

DRANCO PLANT BRECHT I (BELGIUM)

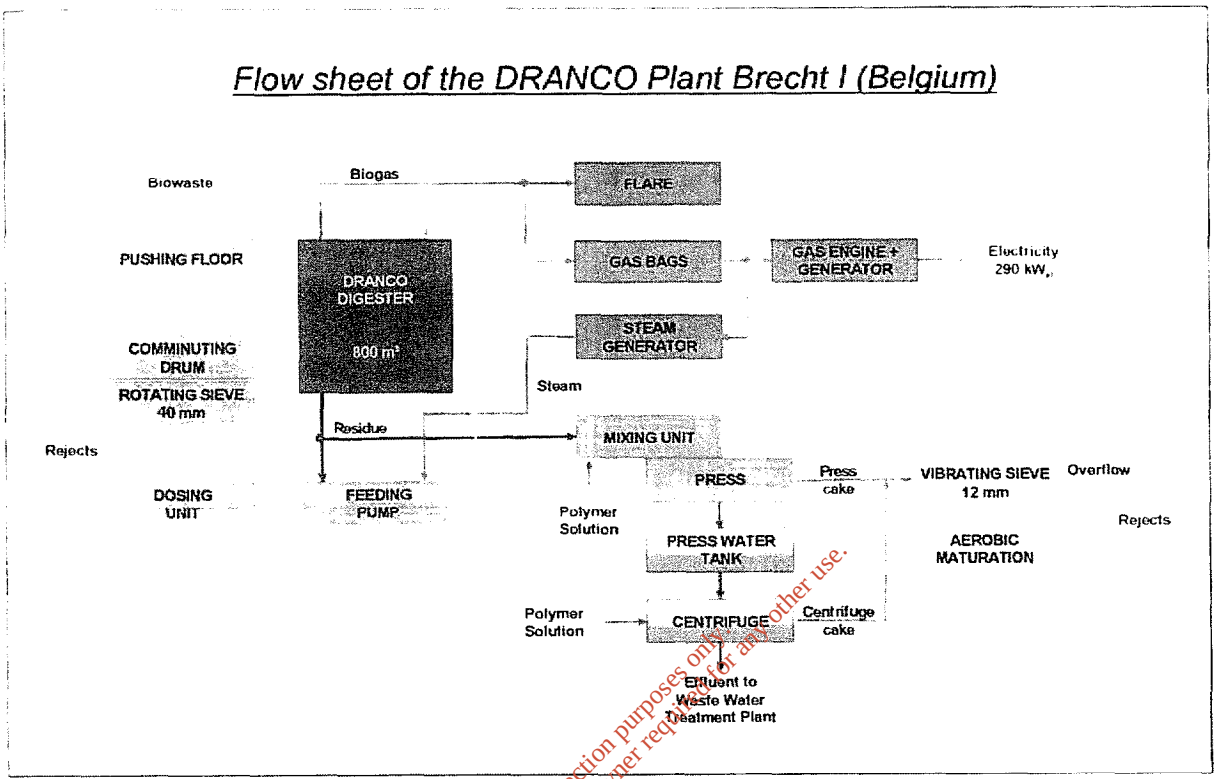


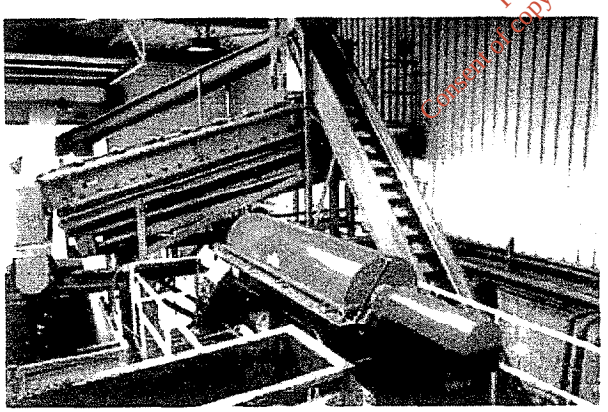
Location :	Brecht, Belgium (near Antwerp)
Capacity :	20.000 tons of biowaste per year
Digester volume :	800 m³
Start-up :	July 1992
Realization time :	March 1991 - June 1992
Client :	IGEAN

OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825

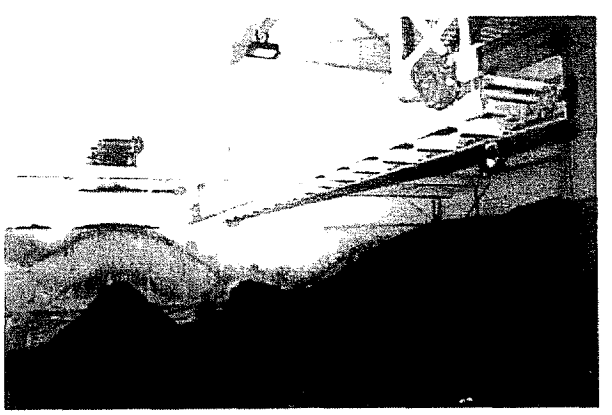
OWS
Organic Waste Systems

Flow sheet of the DRANCO Plant Brecht I (Belgium)





Vibrating sieve for compost refining.
In the front at the right the centrifuge.



The Humotex dividing system in the aerobic maturation hall.

OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825

OWS
Organic Waste Systems

CHARACTERISTICS OF INCOMING BIOWASTE

Total Solids (TS) :	40%
Volatile Solids (VS) on TS :	55%
C/N-ratio :	20

Composition (on wet weight basis) :

Garden waste :	75%
Kitchen waste :	10%
Wet paper :	10%
Industrial waste :	3,5%
Impurities :	1,5%

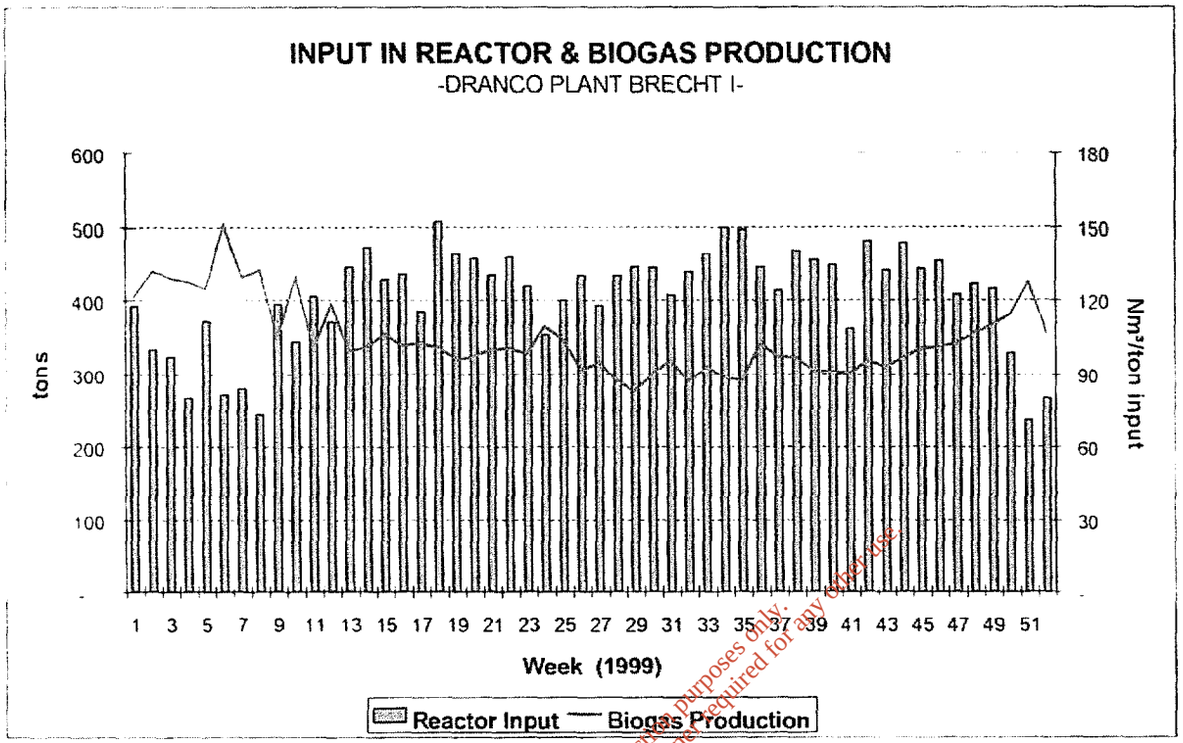
PROCESS PARAMETERS

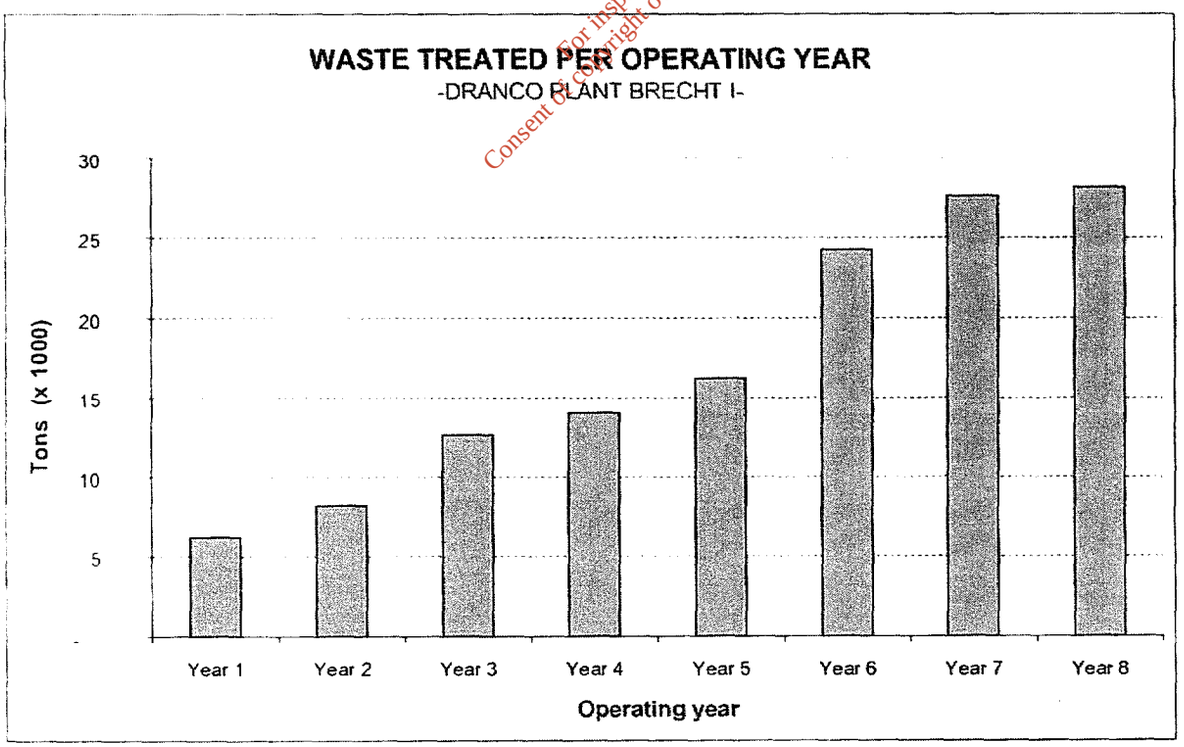
Loading :	7 - 14 kg VS/$m^3_{reactor}$.day
Biogas production :	90 - 120 Nm^3/ton input
Biogas productivity :	4 - 8 $Nm^3/m^3_{reactor}$.day
Methane content :	50 - 60 %
Retention time :	15 - 25 days
TS-content in the digester :	28 - 40 %

QUALITY OF THE COMPOST

Total Solids (TS) :	57,8%
Volatile Solids (VS) on TS :	37,4%
pH :	7,9
Salt content :	1,1 mS/cm
Ammonium nitrogen :	215 mg/l Humotex
Nitrate nitrogen :	53 mg/l Humotex
Total nitrogen :	0,82%
Heavy metals :	below standards
Fertilization value :	high for P, moderate for K, Ca and Mg
Weed seeds :	none
Phytotoxicity :	none
Applications :	soil conditioner, potting substrate

OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825





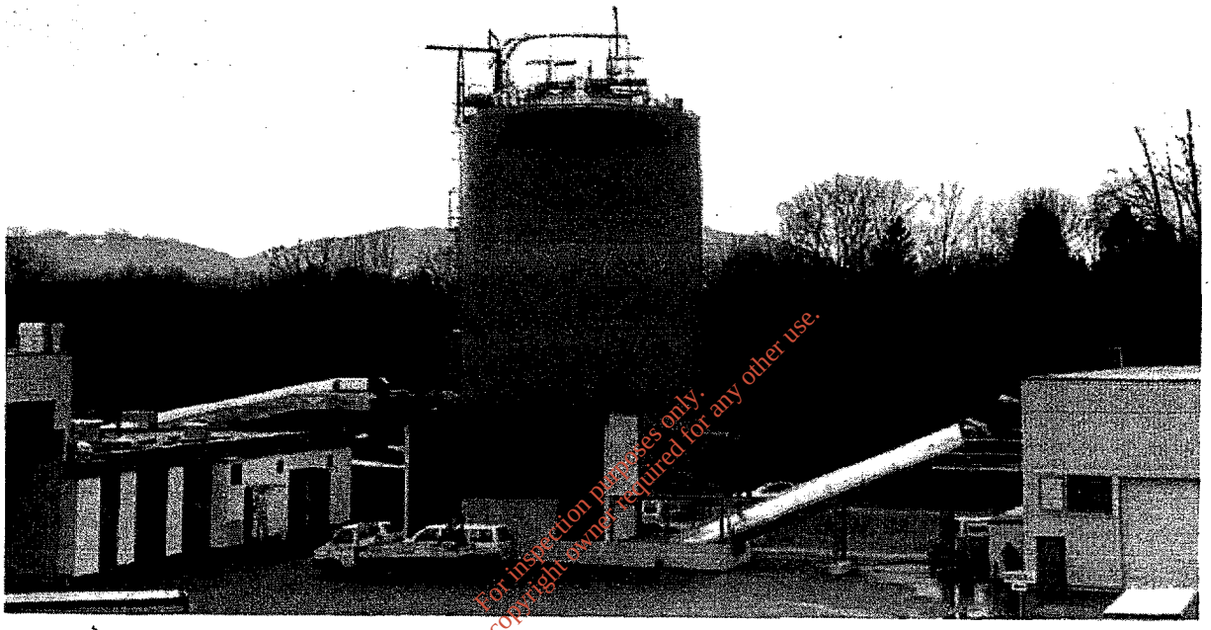
OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825

002

G02

OWS
Organic Waste Systems

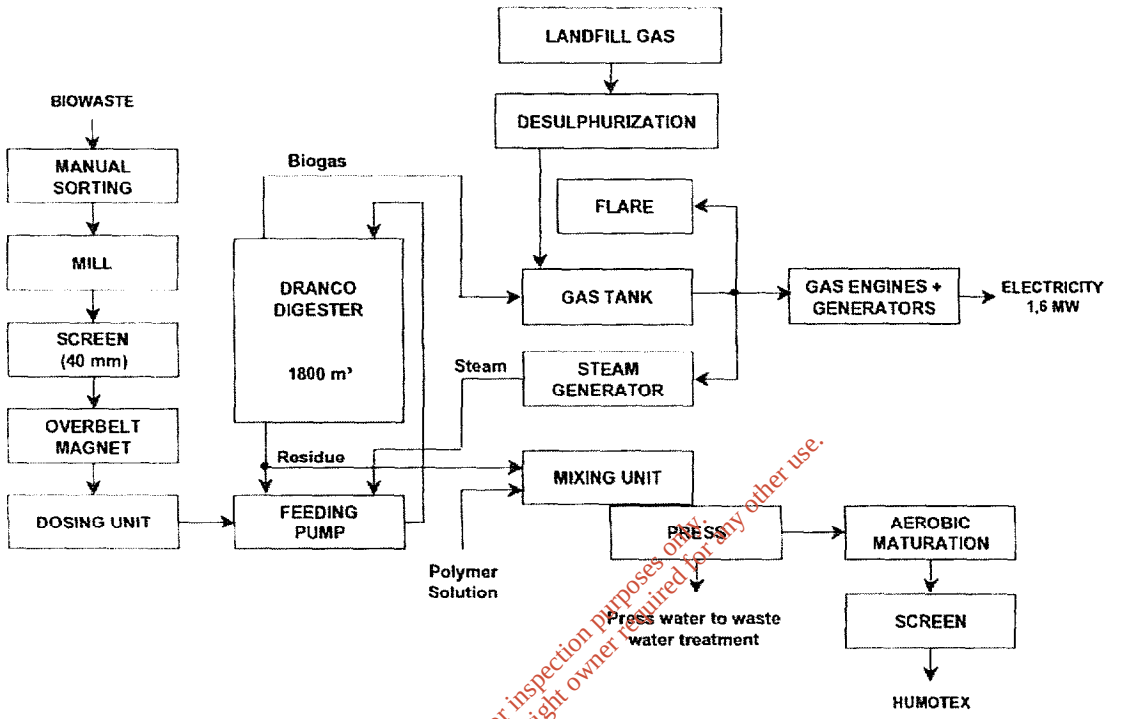
DRANCO PLANT SALZBURG (AUSTRIA)

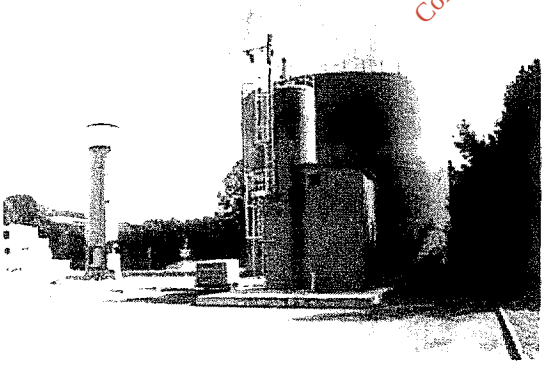


Location :	Bergheim-Siggerwiesen, Austria (near Salzburg)
Capacity :	20.000 tons of biowaste per year
Digester volume :	1.800 m³
Start-up :	December 1993
Realization time :	16 months
Client :	Salzburger Abfallbeseitigung Gesellschaft (SAB)

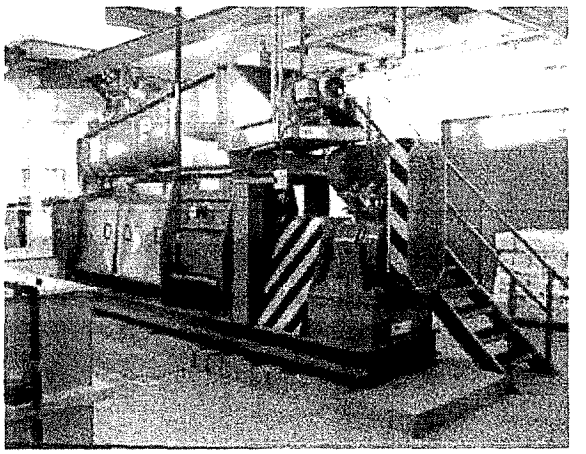
OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825

Flow sheet DRANCO Plant in Salzburg (Austria)





Gas storage and flare for biogas and landfill gas. In the front at the right the desulphurization unit for landfill gas.



Screw press for dewatering of the residue.

OWS
Organic Waste Systems

CHARACTERISTICS OF INCOMING BIOWASTE

Total Solids (TS) :	31%
Volatile Solids (VS) on TS :	70%
C/N-ratio :	19

Composition (on wet weight basis) :

Garden waste :	20%
Kitchen waste :	63,5%
Industrial waste :	15%
Impurities :	1,5%

PROCESS PARAMETERS

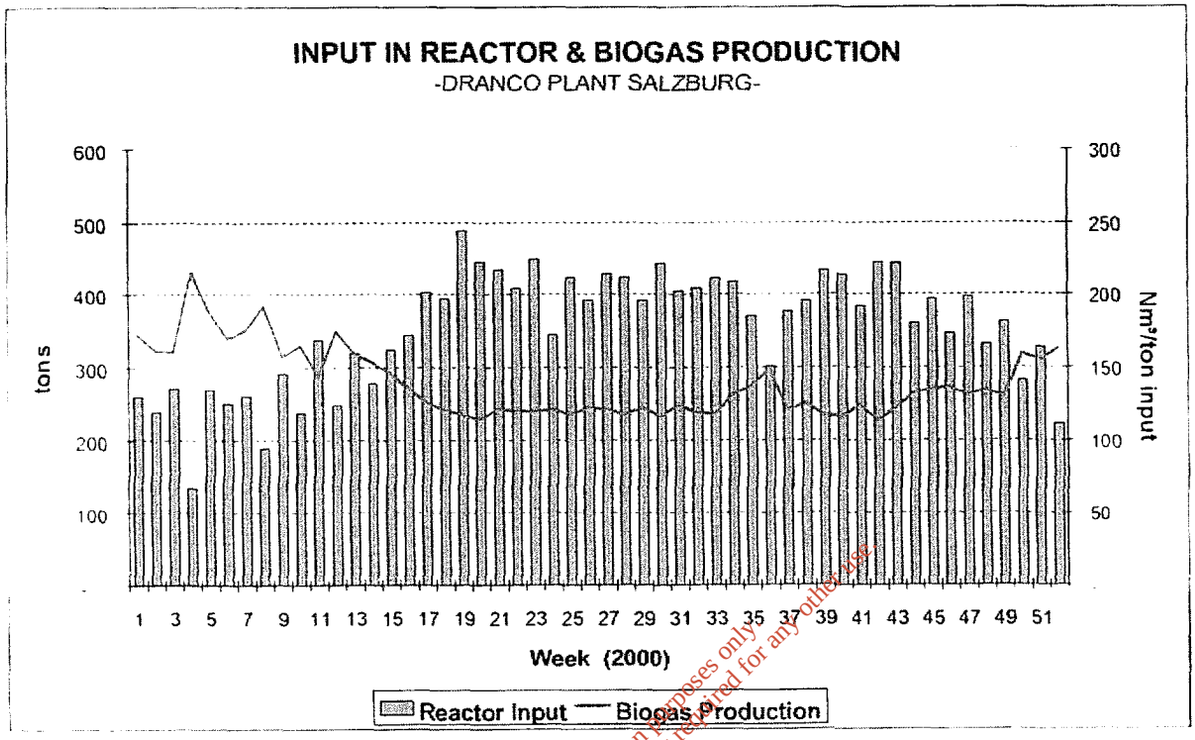
Loading :	5 - 8 kg VS/$m^3_{reactor}$.day
Biogas production :	120 - 170 Nm^3/ton input
Biogas productivity :	3 - 5 $Nm^3/m^3_{reactor}$.day
Methane content :	50 - 65 %
Retention time :	20 - 30 days
TS-content in the digester :	18 - 26 %

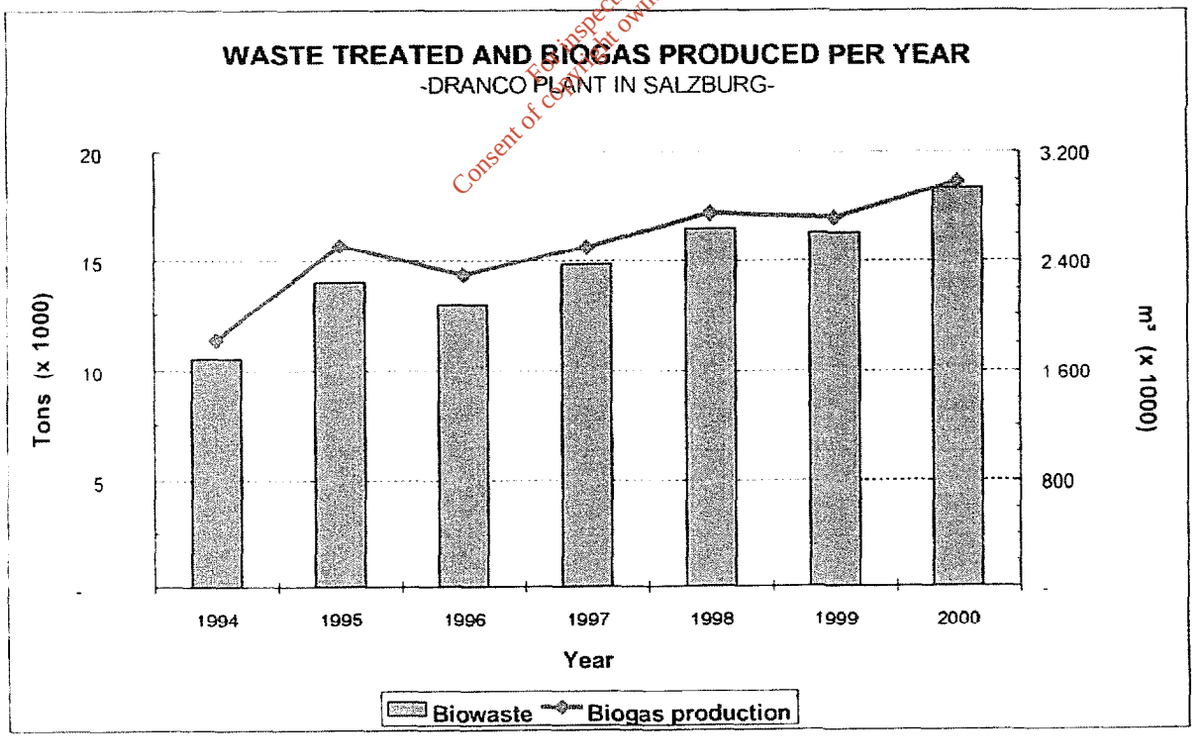
QUALITY OF THE COMPOST

Level of maturity :	V
Total Solids (TS) :	51%
Volatile Solids (VS) on TS :	41%
Kj-N on TS :	1,9%
pH :	7,7
Salt content :	0,7 mS/cm
Chrome :	37 mg/kg TS
Nickel :	24 mg/kg TS
Copper :	53 mg/kg TS
Zinc :	200 mg/kg TS
Cadmium :	< 1 mg/kg TS
Lead :	44 mg/kg TS

OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825

OWS
Organic Waste Systems

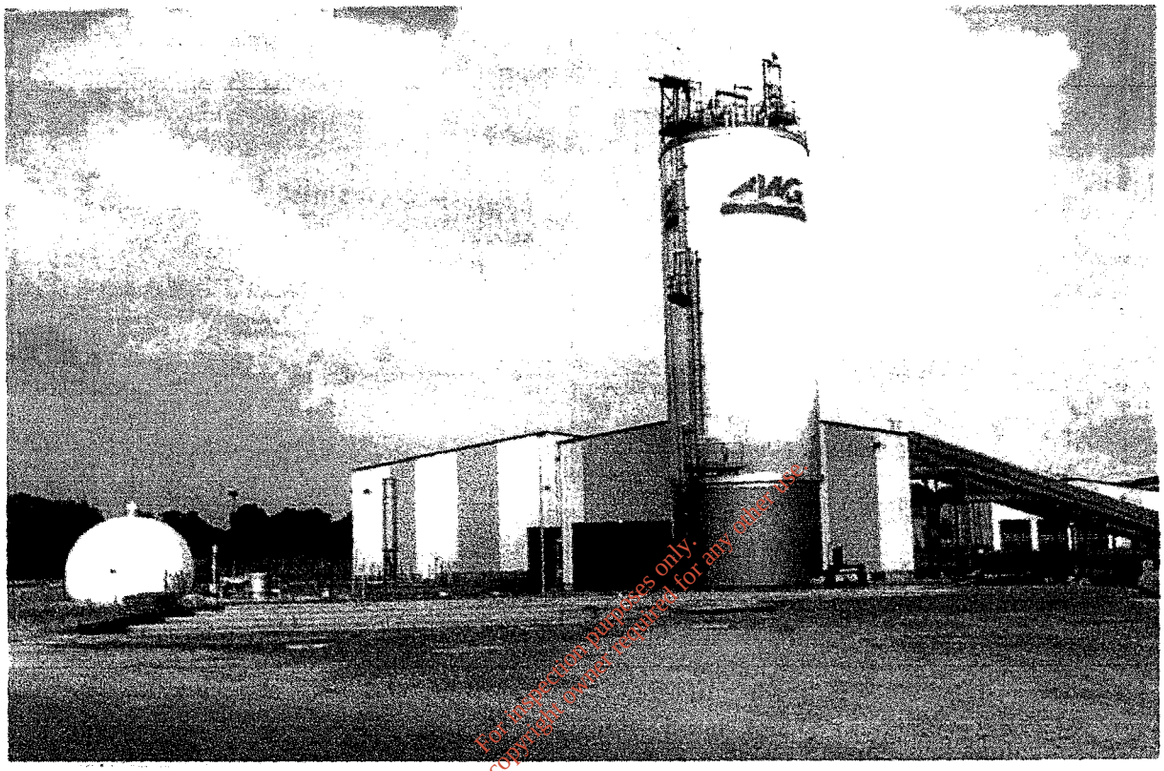




OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825

OWS
Organic Waste Systems

DRANCO PLANT BASSUM (GERMANY)

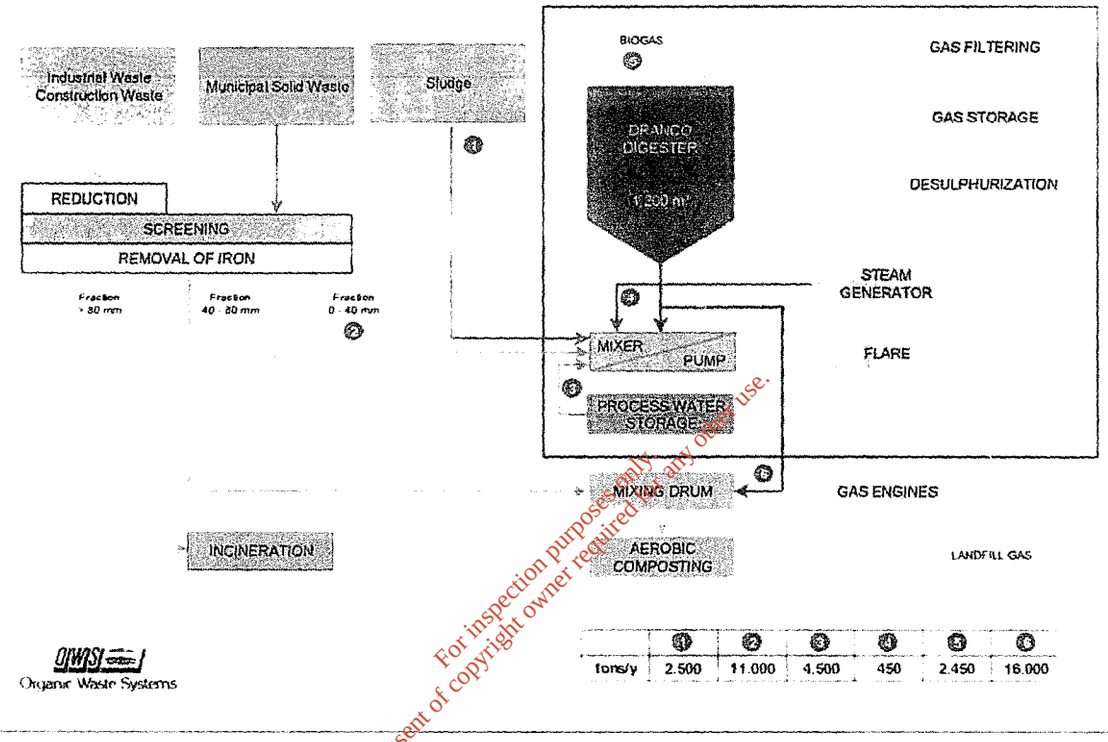


Location :	Bassum, Germany
Capacity :	13.500 tons of grey waste per year
Digester volume :	1.200 m³
Start-up :	June 1997
Realization time :	May 1996 - June 1997
Client :	AbfallWirtschaftsGesellschaft mbH (AWG)

OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825

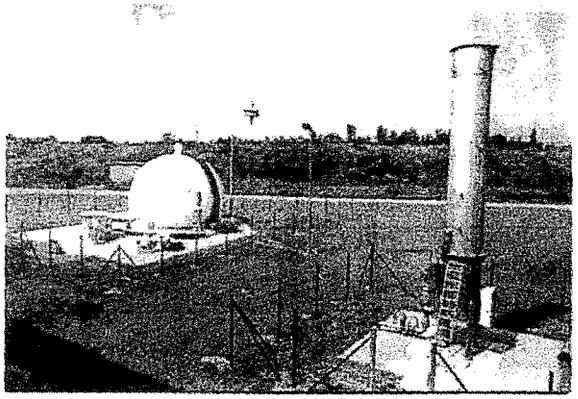
OWS
Organic Waste Systems

DRANCO INSTALLATION
FOR THE TREATMENT OF RAW WASTE IN BASSUM (Germany)



	①	②	③	④	⑤	⑥
tons/y	2.500	11.000	4.500	450	2.450	16.000

Grey waste



The gas storage and flare.

OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel +32 9 2330204 • fax +32 9 2332825

OWS
Organic Waste Systems

DIGESTION MASS BALANCE

	Basis		Exploitation performance			
	Case I	Case II	1998		1999	
	ton/y	ton/y	ton/y	%	ton/y	%
INPUT						
Grey waste (< 40 mm)	11.850	11.000	7.050	63,5	9.000	66,2
Paper waste	0	0	1.650	14,9	2.200	16,2
Paper sludge	0	0	250	2,3	0	0
Biowaste	0	0	0	0	500	3,7
Sludge	0	2.500	0	0	0	0
Total waste	**11.850**	**13.500**	**8.950**	**80,6**	**11.700**	**86,0**
Process water (incl. steam)	6.850	5.200	2.150	19,4	1.900	14,0
Total input	**18.700**	**18.700**	**11.100**	**100**	**13.600**	**100**
OUTPUT						
Residue	16.700	16.700	9.500	85,6	11.600	85,3
Biogas	2.000	2.000	1.600	14,4	2.000	14,7
Total output	**18.700**	**18.700**	**11.100**	**100**	**13.600**	**100**

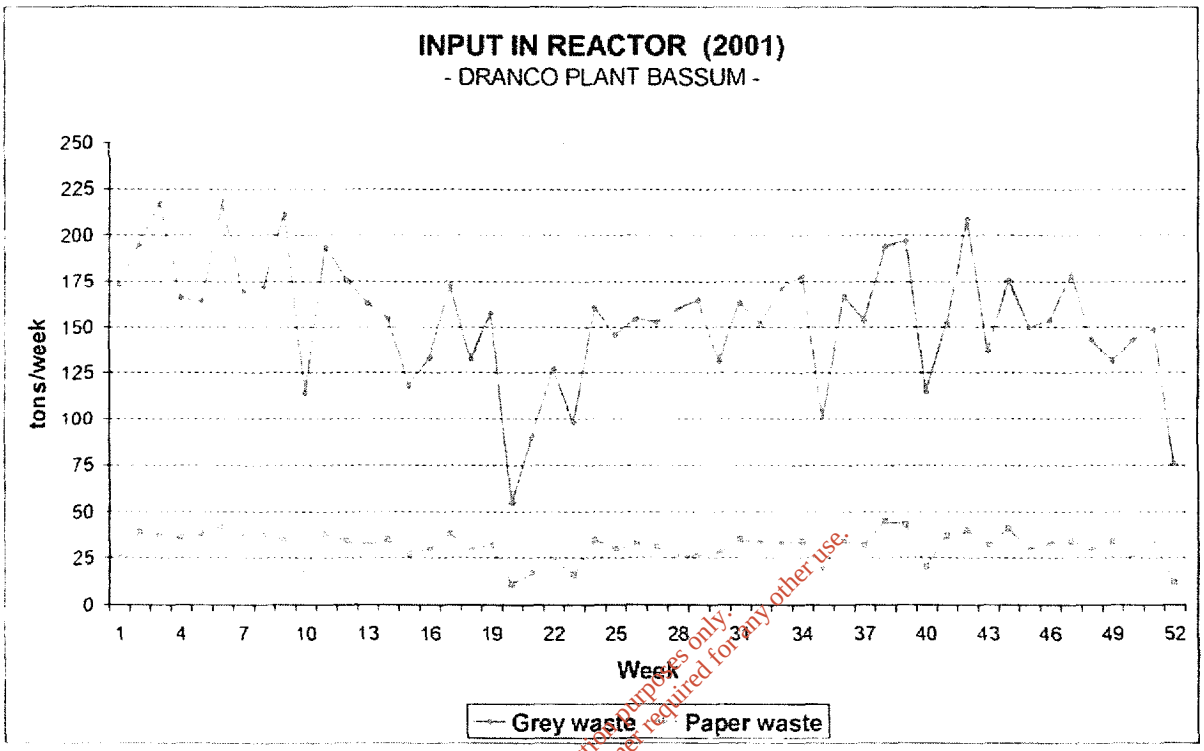
WASTE CHARACTERISTICS

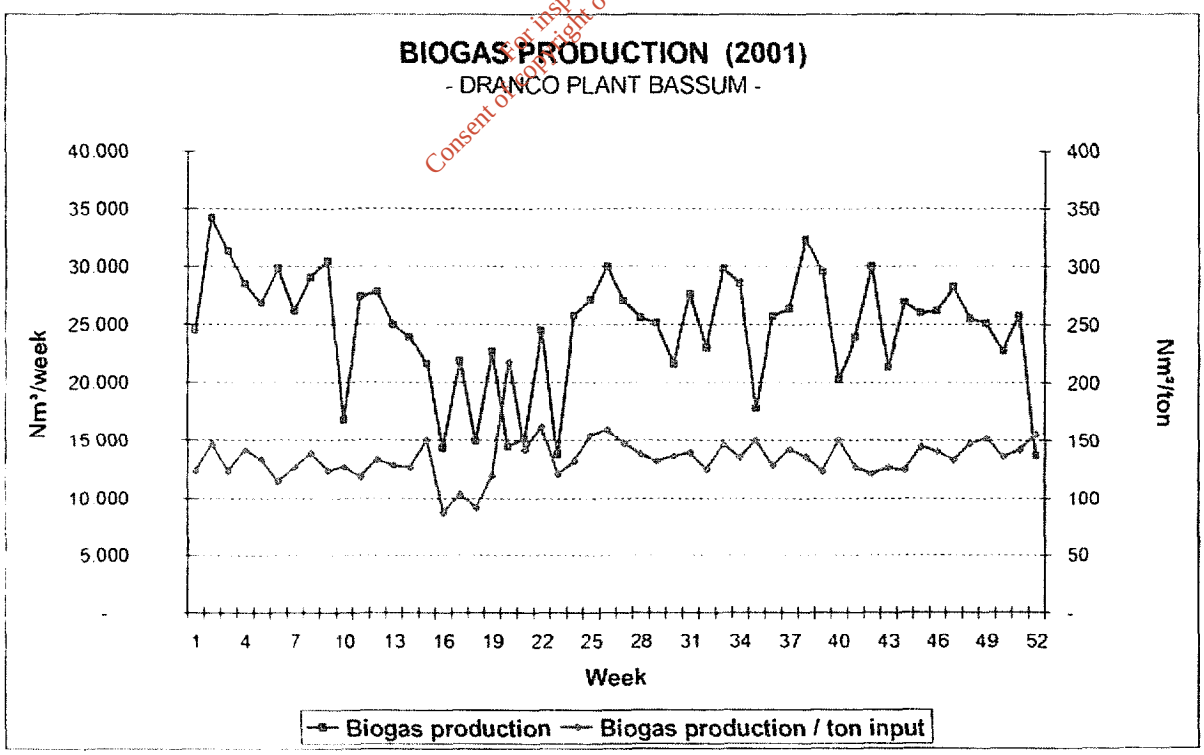
Parameter	Unit	Grey waste	Paper waste	Total input
Water content	%	40 – 45	35 - 55	44
Total Solids (TS)	%	55 - 60	45 - 65	56
Volatile Solids (VS) on TS	%	43 - 50	90 - 95	51
TOC	%	21 - 25	47 - 49	25
C/N-ratio		21	240	30

PROCESS PARAMETERS

Parameter	Unit	1998/1999
Retention time	days	25
Total Solids (TS) of the output	%	39 - 42
Volatile Solids (VS) on TS of the output	%	33 - 35
Biogas production	Nm^3/ton input	133 - 140
Biogas production	Nm^3/ton TS	240 - 250
Biogas production	Nm^3/ton VS	460 - 490
Biogas productivity	kg TS/$m^3_{reactor}$.d	17 - 20
Biogas productivity	kg VS/$m^3_{reactor}$.d	8 - 10

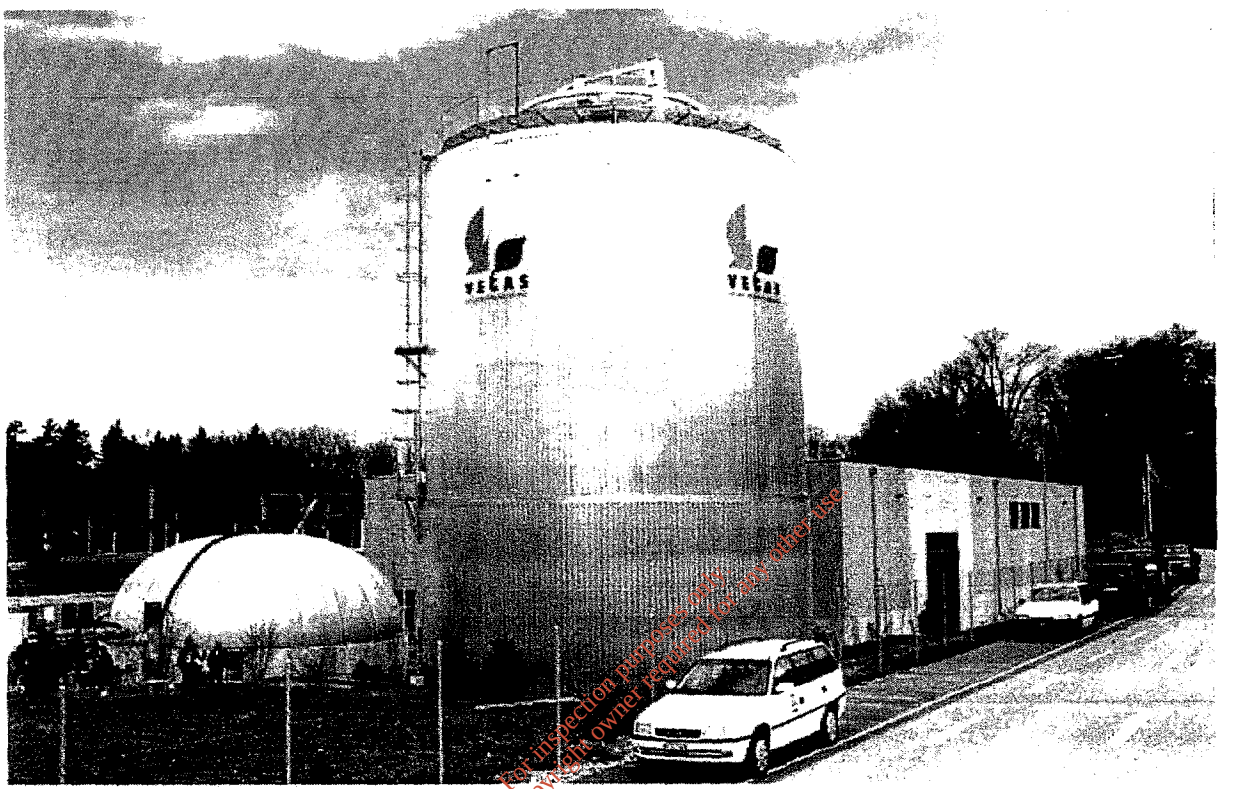
OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825





OWS
Organic Waste Systems

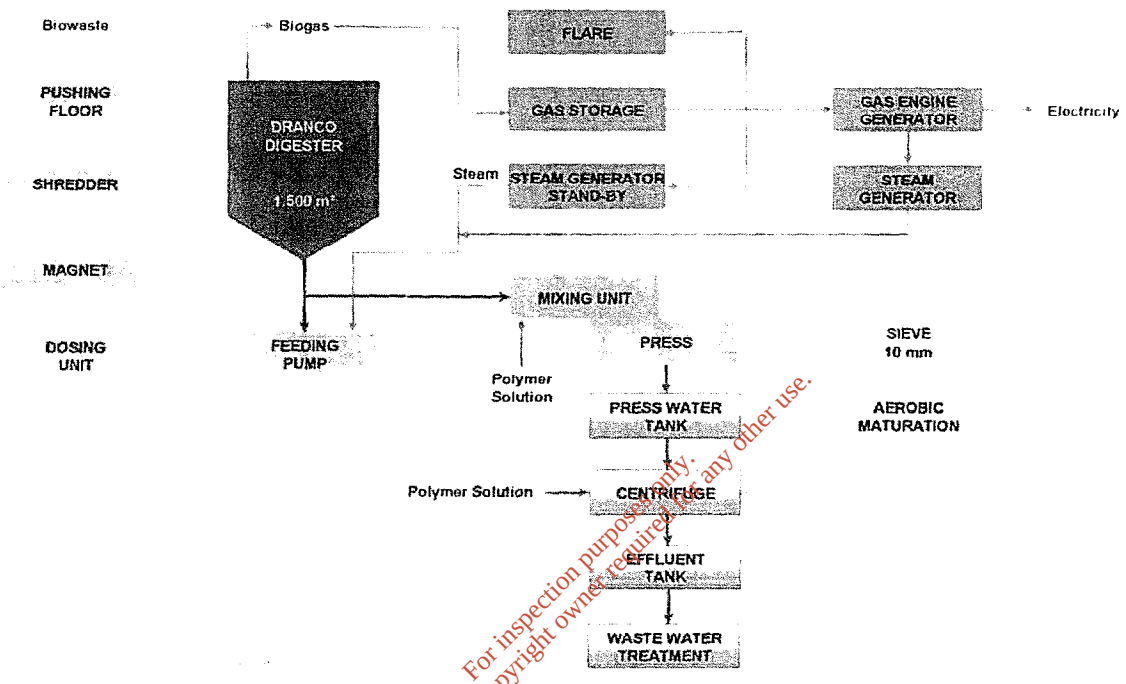
DRANCO PLANT AARBERG (SWITZERLAND)



Location :	Aarberg, Switzerland
Capacity :	11.000 tons of biowaste per year
Digester volume :	1.500 m³
Start-up :	January 1998
Realization time :	August 1996 - December 1997
Client :	Vergärungsanlage Seeland AG (VEGAS)

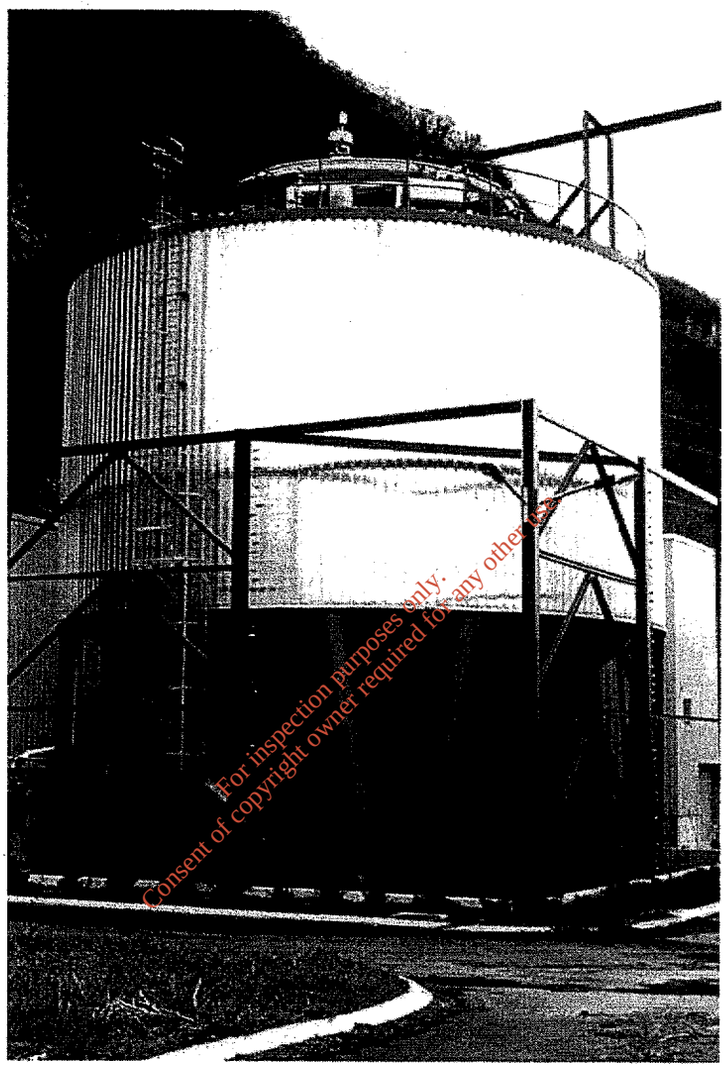
OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825

Flow sheet DRANCO Plant Aarberg (Switzerland)



Organic Waste Systems

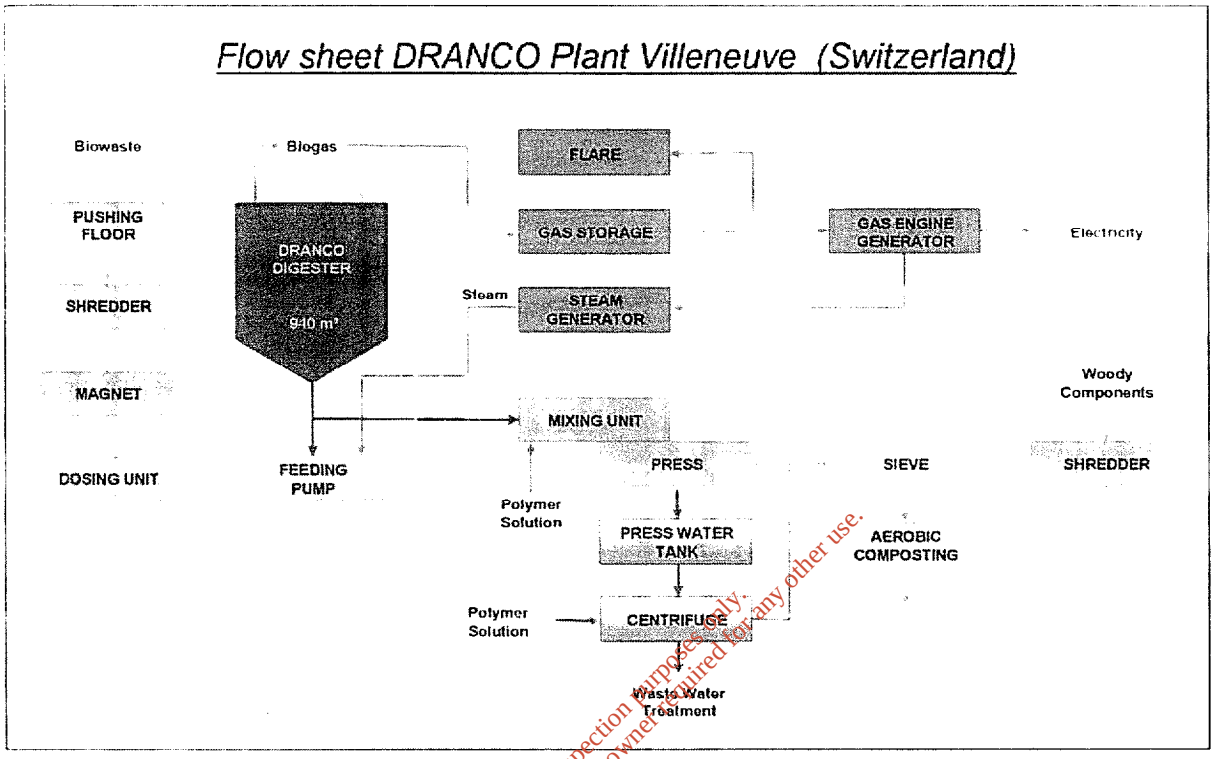
DRANCO PLANT VILLENEUVE (SWITZERLAND)



Location :	Villeneuve, Switzerland
Capacity :	10.000 tons of biowaste per year
Digester volume :	940 m³
Start-up :	February 1999
Realization time :	January 1998 - February 1999
Client :	SA Compost Chablais-Riviera

OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825

OWS
Organic Waste Systems



OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www ows be • tel. +32 9 2330204 • fax +32 9 2332825

OWS
Organic Waste Systems

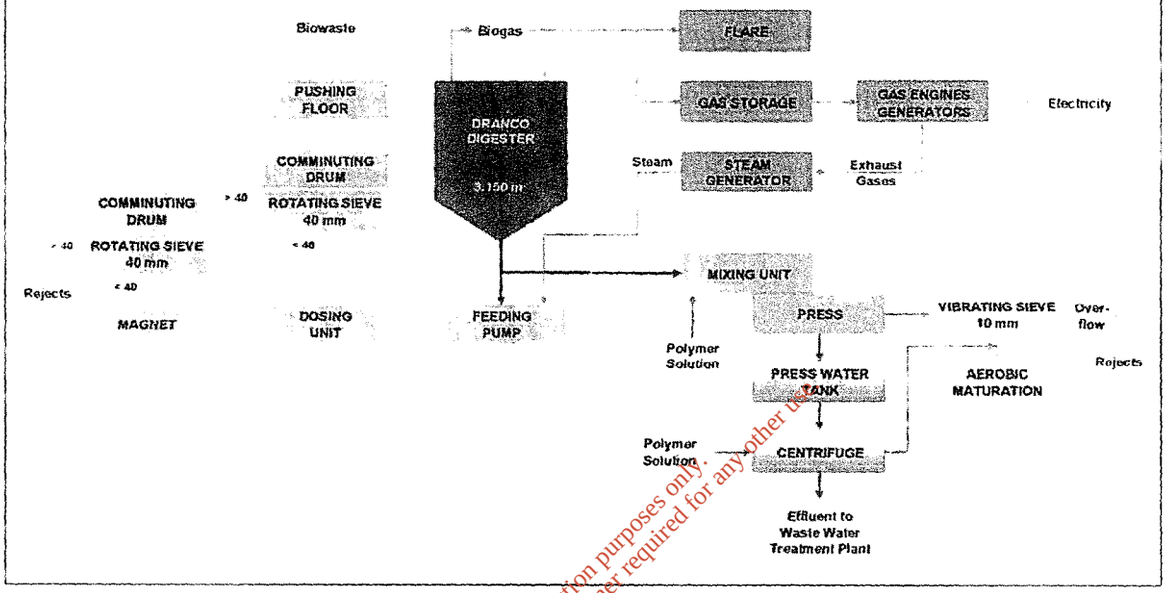
DRANCO PLANT BRECHT II (BELGIUM)

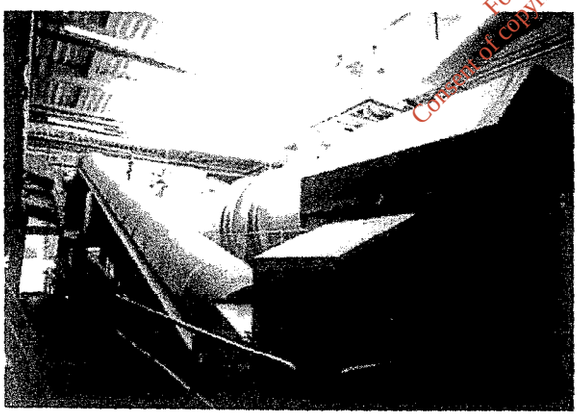
Location :	Brecht, Belgium (near Antwerp)
Capacity :	50.000 tons of biowaste per year
Digester volume :	3.150 m³
Start-up :	January 2000
Realization time :	July 1998 - December 1999
Client :	IGEAN

OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825

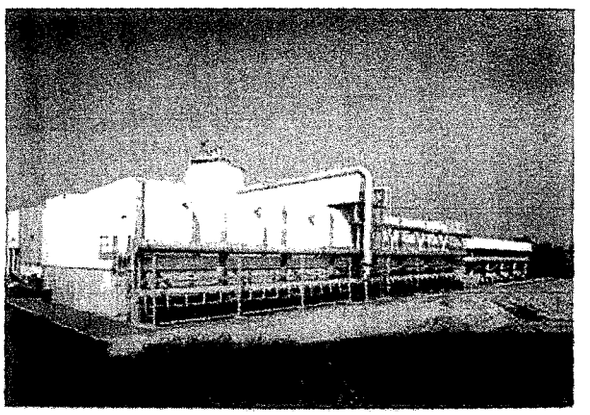
OWS
Organic Waste Systems

Flow sheet of the DRANCO Plant Brecht II (Belgium)



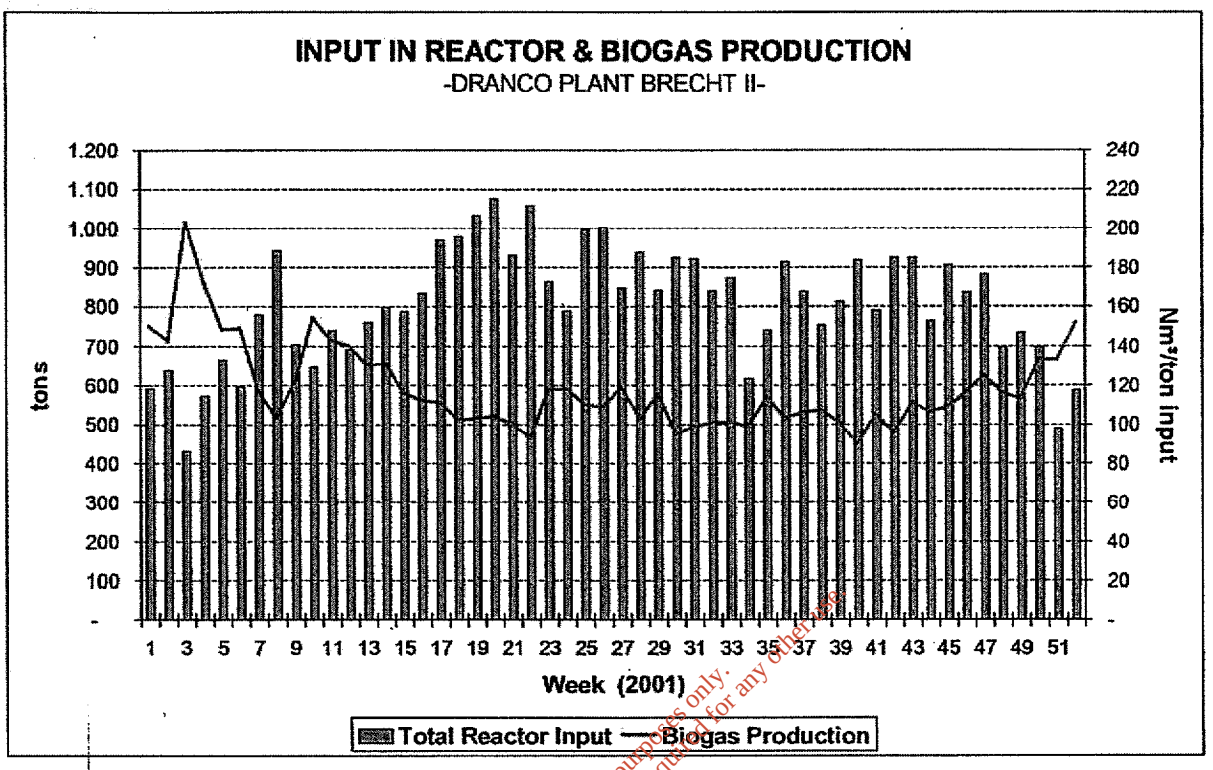


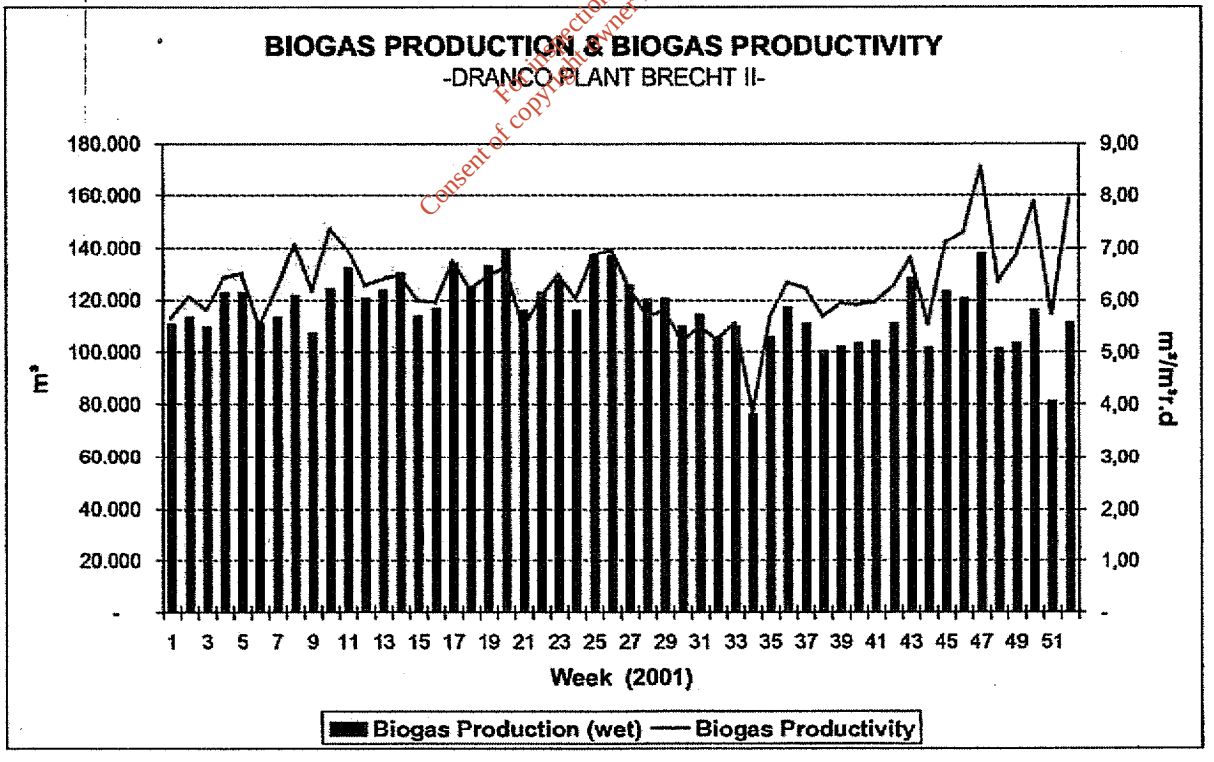
Comminuting drum for the selective reducing of the incoming waste.



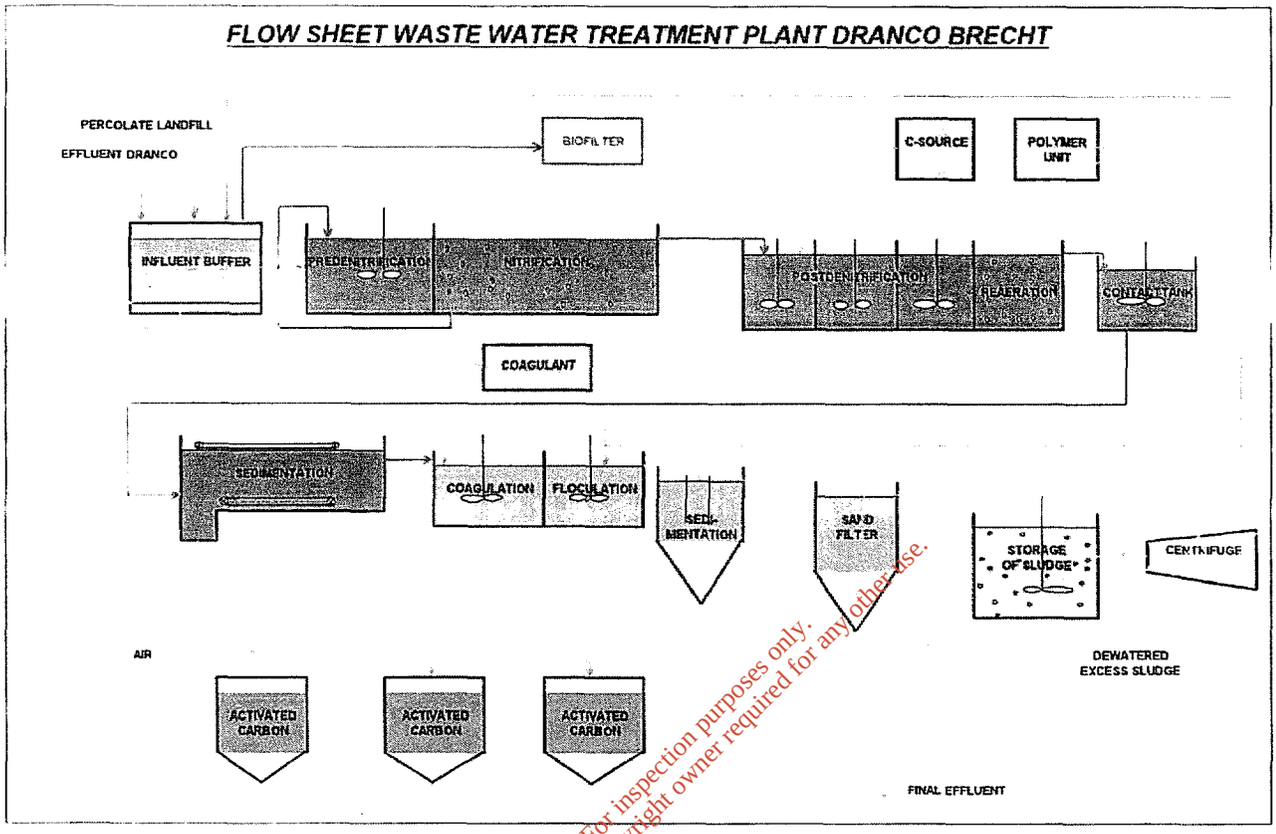
At the back of the aerobic maturation hall.

OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825

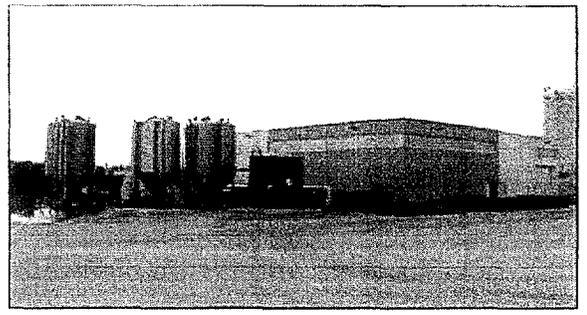




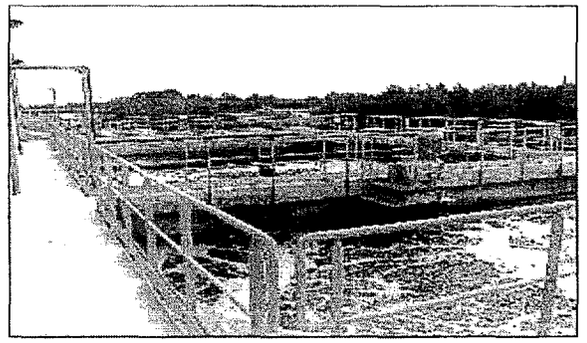
FLOW SHEET WASTE WATER TREATMENT PLANT DRANCO BRECHT



COMPOSITION INPUT WASTE WATER TREATMENT		
Parameter	**Unit**	**Average**
Capacity	m^3/d	173
COD_{total}	mg/l	12.710
	kg/d	2.200
Ratio BOD_{5d}/ COD_t		0,44
Kj-N	mg/l	1.450
	kg/d	255
Ratio CODt/Kj-N		8,6
TSS	mg/l	2 765

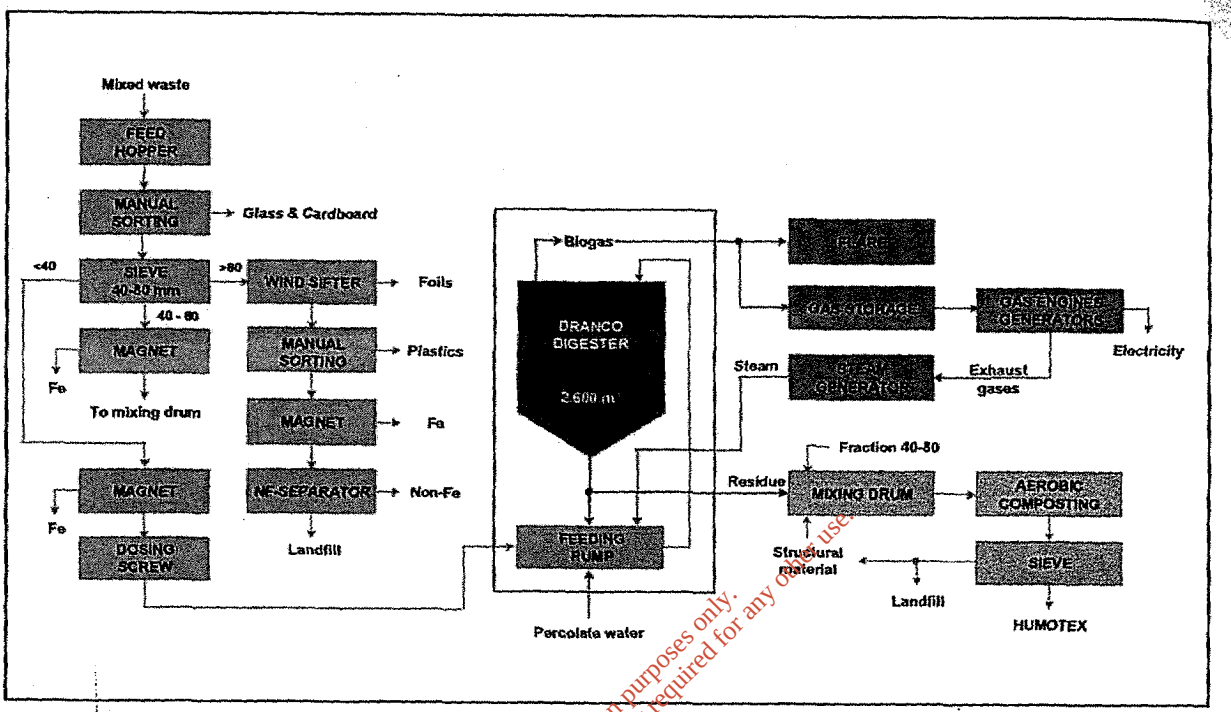


COMPOSITION OUTPUT WASTE WATER TREATMENT			
Parameter	**Unit**	**Effluent**	**Discharge limits**
Capacity	m^3/d	173	234
COD_{total}	mg/l	125	125
BOD_{total}	mg/l	25	25
K_j-N	mg/l	12	12
NH_4-N	mg/l	2	10
NO_x-N	mg/l	5	10
P_{total}	mg/l	0	2
SO_4^{2-}	mg/l	200	800
Conductivity	µS/cm	6 000	6 000



OWS Organic Waste Systems

DRANCO PLANT ALICANTE (SPAIN)

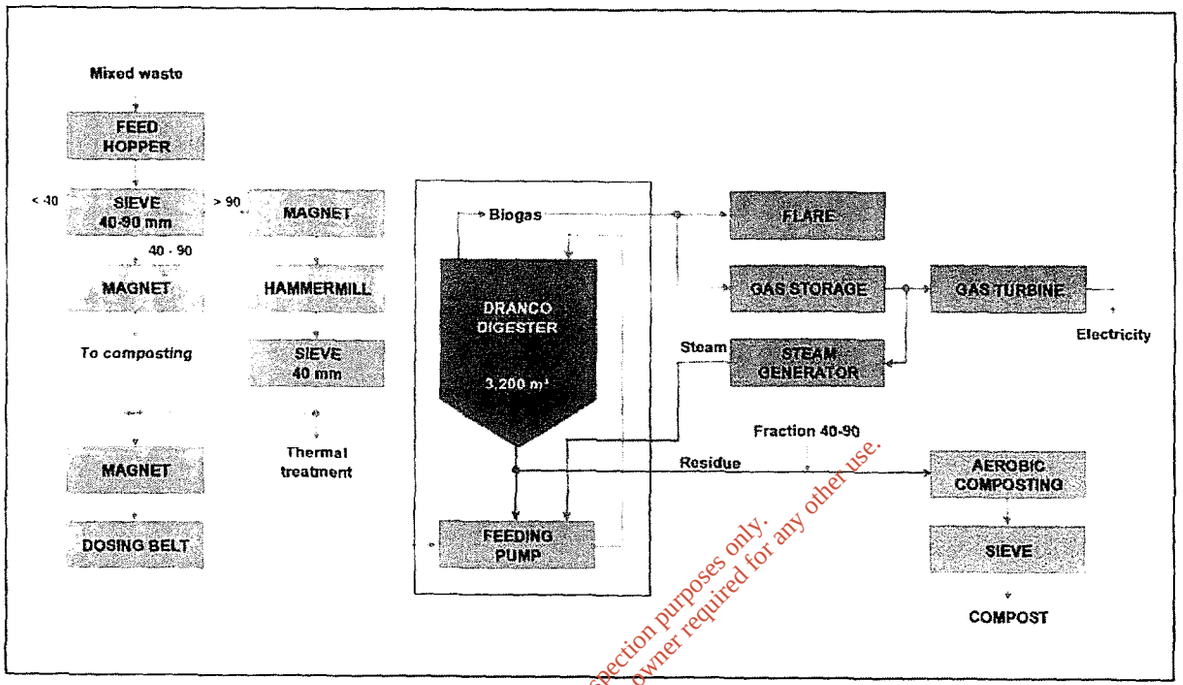


Location :	Alicante, Spain
Capacity of the plant :	120.000 tons of mixed waste per year
Capacity of the digestion part :	30.000 tons of mixed waste per year
Digester volume :	2.600 m³
Start-up :	Planned for 2002
Client :	Ingenieria Urbana S.A. (group CESPA)

OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www.ows.be • tel. +32 9 2330204 • fax +32 9 2332825

OWS
Organic Waste Systems

DRANCO PLANT ROME (ITALY)



Location :	Rome, Italy
Capacity of the digestion part :	40.000 tons of mixed waste per year
Digester volume :	3.200 m³
Start-up :	Planned for 2002
Client :	E. GIOVI S.r.l. (group SORAIN CECCHINI)

OWS NV • Dok Noord 4 • B-9000 Gent • Belgium
www ows be • tel. +32 9 2330204 • fax +32 9 2332825