

Case study: Odour Measurement at the Anaerobic Digestion Plant of Lisbon Area

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Due to some complaints from the neighbourhood, an odour monitorization campaign according to the EN 13725:2003 was done in the anaerobic digestion plant of Valorsul. This campaign demonstrated that one of the biofilters was not performing according with the guarantee parameters, namely i) odour removal > 95% or max value < 300 OU/m³ and ii) NH₃ removal > 95% or max value < 50 ppm. Facing this situation, the contractor implemented a new scrubber, with a bigger capacity, in respect to the air inflow than the one installed since the beginning of the operation, in order to ensure the humidification of the total air from the plant buildings and tanks. The biofilter material was also replaced, in global, with coconut fibres (before this modification it was made of wood from pine tree).

1. Introduction

Biodegradable waste is separately collected in restaurants, hotels, supply and retail markets among other big producers of this kind of waste in the municipalities of Lisbon Area. The plant was designed to process 40 thousand Mg of biodegradable waste per year in a first stage and 60 thousand Mg per year in a future second stage.

In terms of electric energy and compost, the plant can produce, respectively, 10 GWh and 14 Mg per year. The process consists in a wet two-stage thermophilic anaerobic digestion process. After the digestion step, the organic suspension is dewatered and pre-composted in 5 tunnels, with forced aeration and post-composted in windrows in a covered area. The final compost is refined by passing through a sieve and a densimetric table to remove contaminants.

Figure 1 presents the process flow diagram.

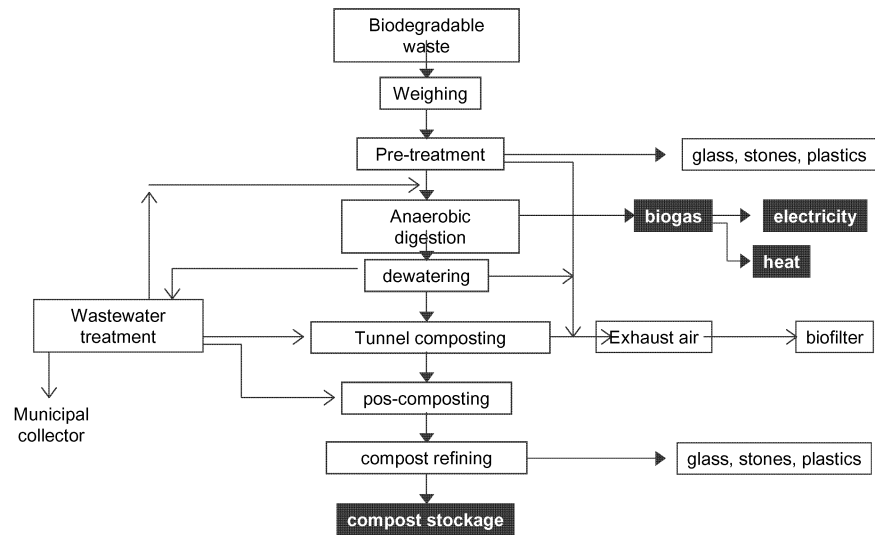
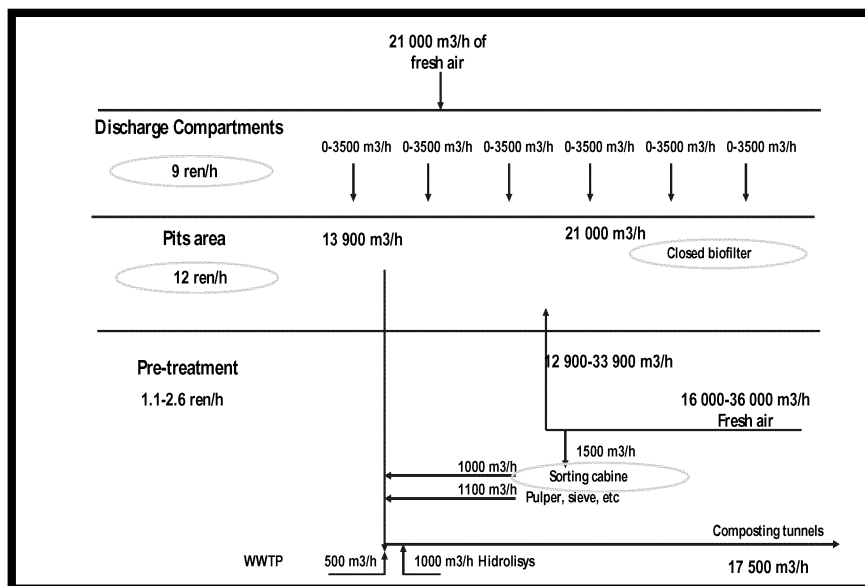


Figure 1. Process flow diagram.

Referring to the exhaust air extraction and treatment system, and in order to prevent the emission of odour, the plant was designed to extract a flow of 50 000 m³/h of exhaust air. This flow is ventilated by two systems situated in the reception/treatment hall (17 500 m³/h) and in the dewatering building (10 000 m³/h). Some critical equipments and tanks are also ventilated, like the pulper, sieve drum, hydrolysis, Waste Water Treatment Plant (WWTP) and others. As a result, 27 500 m³/h of the air extracted is used as process air in the tunnel-composting phase that comes from the flows extracted in two main areas: reception and pre-treatment building and dewatering room. The exhaust air from the tunnels is transported to a scrubber before treatment.

Figure 2 presents the scheme of the air extraction system in the reception building.



As it can be seen, in the discharge compartments and in the pit areas, there is a Renovation Extraction Rate (RER) of 9 and 12 ren.air/hour, respectively.

In the sorting cabin, an AVAC system is implemented and a 500 m³/hour of fresh air is guaranteed with an RER of 10 ren.air/hour.

Due to the high concentration of ammonia (NH₃) that is released from the digested material in the dewatering phase, all the equipments in the dewatering building (centrifuges and the conveyor) are closed with direct extraction air conducts. The RER in the room and in these equipments has the value of 6 ren.air/hour.

The total air extracted is treated in two biofilters: i) a closed container with a capacity of 20 000 m³/h that treats the air extracted from one of the bunkers and ii) an open biofilter, fed with 30 000 m³/h and dimensioned with a specific load of 100 m³/m² h. In the container biofilter the bed material is made of pine tree wood and coconut fibres while in the open biofilter the material is mainly of coconut fibres. Figure 3 shows the images of the two existing biofilters.

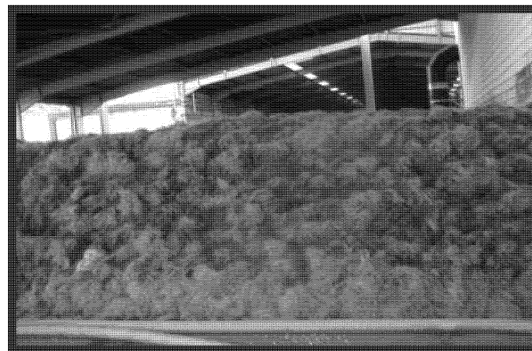


Figure 3. Images of the biofilters.

This paper aims to present the results of the odour monitorization campaign that took place at the anaerobic digestion plant of Valorsul and to describe the measures that were implemented afterwards, in order to ensure the performance of the exhaust air extraction and treatment system.

2. Monitorization Campaigns – odours and chemical parameters

Recently, due to some complaints from the neighbourhood, Valorsul has implemented between 14 and 16 of March 2007 an odour monitorization campaign, according to the EN 13725:2003, in order to verify the performance of the two existing biofilters, in terms of odour emission (OUE/m³) and also to check the relation of odours and concentration of some chemical parameters like ammonia, hydrogen sulphide, total organic carbon and mercaptans.

In terms of the guarantee values referred in the contractual agreement made with the supplier, the existing biofilters have to be performed with a i) odour removal > 95% or max value < 300 OU/m³ and ii) NH₃ removal > 95% or max value < 50 ppm.

Before the beginning of the campaign, the sampling hours were chosen taking into account the operation conditions, in terms of the worst periods in odours emissions, by accumulating the activities related with the waste processing that included the operation in the two pits, the starting of the pre-treatment operations, and the operation of the centrifuges in the dewatering phase.

The samplings were made at the inlet air pipes of the two biofilters and in the outlet: i) in the exhaust air chimneys of the container biofilter and ii) in several points on the surface of the open biofilter as it can be seen in figure 5.

In order to ensure the representativeness of the outlet sampling in the open biofilter, it was defined, in the surface area, a grid with eight parts. The sampling collection was performed through a campanula with an area of 1 m² that was displaced in the centre of each one of the eight parts/areas referred above. Face to this methodology, it was possible to analyse 8 m² of the open biofilter, which represents 3% of the total area.

Figure 4 shows the sampling scheme in the surface of the open biofilter. The sampling collecting was made according to the EN 13725:2003 and the odour determination through the utilization of dynamic olfatometric equipment.

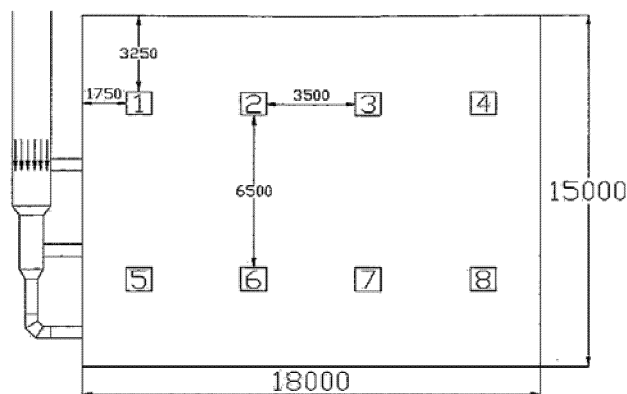


Figure 4. Sampling scheme in the surface of the open biofilter.

The odour concentration results obtained are presented in Tables 1 and 2.

Table 1. Odour concentration in the container biofilter.

Container Biofilter	Exhaust air chimneys				Inlet air pipes		
	No waste processing (NWP)				Waste processing (WP)		NWP
Operation conditions	G/H	E/F	C/D	A/B	Water moisture	Water moisture	No water moisture
Average values (OU _E /m ³)	113	70	55	33	885	1500	510

Container Biofilter	Exhaust air chimneys				Inlet air pipes	
	Waste processing (WP)					
Operation conditions	G/H	E/F	C/D	A/B	Water moisture	
Average values (OU _E /m ³)	76	120	140	130	900	

Table 2. Odour concentration in the open biofilter.

Sampling points	Operations Conditions (with water moisture)	Average values (OU _E /m ³)
Inlet air pipes		
	WP	24667
	NWP	2367
	WP	22500
Surface area		
1	NWP	1007
2	NWP	2250
3	WP (only the pits)	1037
4	WP	1467
5	WP (only the pits)	2200
6	NWP	1300
7	NWP	677
7	WP	3700
9	NWP	620

In terms of the chemical parameters Tables 3 and 4 show the results obtained in respect to the parameters TOC, H₂S, NH₃ and mercaptans, respectively in the container and open biofilters.

Table 3. Results obtained at normal pressure and temperature conditions, in dry matter and in the container biofilter.

Sampling points	units	Inlet air pipes	Exhaust air chimneys			
			G/H	E/F	C/D	A/B
TOC	mg/Nm ³	7,6	4,1	3,2	8,0	5,5
H ₂ S	ug/Nm ³	< 20	<5	12	9	11
NH ₃	ug/Nm ³	1015	9	11	6	11
Mercaptanes	ug/Nm ³	135	79	82	219	102

Table 4. Results obtained at normal pressure and temperature conditions, in dry matter and in the open biofilter.

Sampling points	Operation Conditions	TOC (mg/Nm ³)	H ₂ S (ug/Nm ³)	NH ₃ (ug/Nm ³)	Mercaptanes (ug/Nm ³)
Inlet pipe	NWP				
	WP				
Surface area					
1		723	<6	235	-
2		645	11	14	310
3		369	<6	214	472
4		711	<7	710	1240
5		689	<7	9100	1200
6		148	11	1620	318
7		518	20	11	1310
8		149	<6	1340	286

As may be seen from the data presented in table 1 and 2, this campaign demonstrated that, related to the odour emissions, the open biofilter was not performing according with the guarantee parameters, exceeding in all samples the limit value of 300 OU_E/m³.

Taking into account the results of the chemical parameters referred in tables 3 and 4 and the limit value of concentration of ammonia (NH₃) of 50 ppm (which corresponds to 37,9 mg/m³) we can conclude that the concentrations obtained at both biofilters does not exceed this limit.

Face to this situation, and in order to solve the problem of odour emissions at the open biofilter, the contractor implemented a new scrubber, with a bigger capacity, in respect to the air inflow than the one installed since the beginning of the operation, in order to ensure the humidification of about 30 000 m³/h of the air from the plant buildings and tanks. In the past, only half of the air was treated in such kind of equipment. The

biofilter material was also replaced, in global, with coconut fibres (before this modification it was made of wood from pine tree).

In parallel to the implementation of this new equipment, Valorsul installed also equipment for controlling odours, to be used in specific situations (e.g. opening of tanks). Since these modifications were implemented (in January 2008) there were no longer complaints from the neighbourhood. In a short time, a second campaign will be executed in order to see if these actions were effective.

3. Conclusions

An odour campaign was carried out in order to see the performances of the biofilters implemented at the anaerobic digestion plant of Valorsul.

The results confirmed that in the open biofilter the odour emissions were above the limit of 300 OUE/m³.

Consequently, measures were taken in order to control this situation and to minimize the complaints from the neighbourhood. Future campaigns will validate if these actions were effective.

4. References

EN 13725:2003, Odour concentration measurement by dynamic olfactometry, April 2003.

