DIOXIN PRODUCTION IN THE MSW BIOLOGICAL TREATMENT

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Introduction

A plant designed to produce RDF (Refuse Derived Fuel), began working in 2002 in the Vesta – the Venice's waste management company - facilities, and it is part of an integrated centre including a MSW incinerator and a plant producing quality compost from humid waste, deriving from separated collection of MSW. The integrated centre (Figure 1) is located in the industrial area of Venice, close to the Venice lagoon (a particularly protected environment).

Figure 1: integrated centre of MSW treatment

The RDF plant treats the residual waste from separated collection of MSW (and a little quantity of non Hazardous/Special Wastes); the average quantity of incoming material corresponds to 550 tons per day. The corresponding RDF production is about 350 tons per day (most of which are used to produce energy in the ENEL – Italy's largest power production company - power plant located very close to the integrated centre).

The treatment includes a biological pre-phase to dry the material, with a concurrent biostabilization of the waste; subsequently, a mechanical selection separating the material into different classes is performed, according to the material typology. The average percentages emerging from the treatment are the following:

- RDF 56 % in weight of the incoming material
- Magnetic metals 4 % in weight of the incoming material
- Non magnetic metals 1 % in weight of the incoming material
- Mineral fraction 11 % in weight of the incoming material
- Loss of material (H_2O and CO_2 from biological treatment) 28 % in weight of the incoming material

After a primary crushing phase, a fully automated crane introduces the material into 15 bio-boxes (Figure 2) where the biological treatment phase starts. Due to an automatic control system adjusted to the requirements of the biological conversion process, the easily degradable organic substances contained in urban waste are converted in water and CO_2 by a seven-days biodegradation process.

A mix of fresh air and air coming from the system's recirculation device (Figure 2) is injected from the bottom of the bio-box.

The eventual liquid produced from the reactions, collected from the bottom of the bio-box, is sprayed on the material from the top, giving to bacteria the best working conditions.

The temperature increases up to 50°C in the central part of the seven-days process (Figure 5). Exhausted air (coming out from the bio-box), are treated by a thermal system working at 850 °C called LARA..

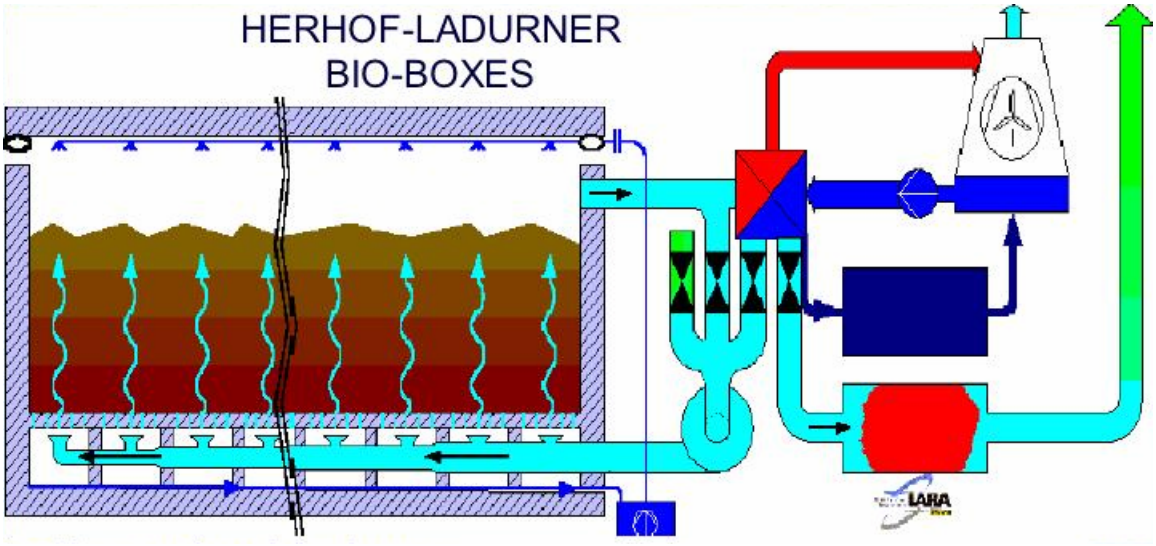
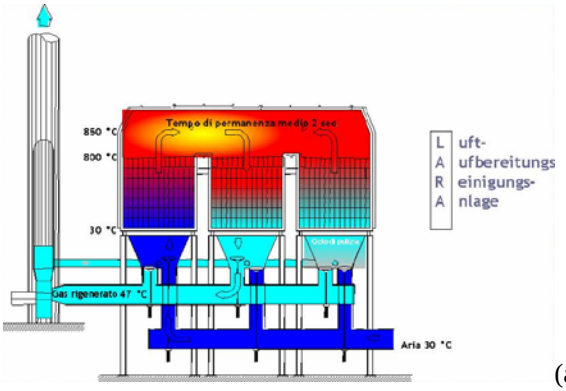


Figure 2: bio-box functioning layout



(a)

(b)

Figure 3: (a) LARA thermal treatment functioning layout and (b) corresponding photo

Materials and methods

It was investigated the possibility of PCDD/PCDF production during the biological treatment process, given the MSW plastic content and the low temperature reached in the bio-boxes. A first series of analytical tests was carried out on in one box (bio-box n° 15), on the following different material flows of the process (Figure 4):

1. Incoming fresh air (8 hours sampling);
2. Exhausted air outside from the box (8 hours sampling);
3. Treated air outside from LARA system (8 hours sampling);
4. Incoming waste after the primary crushing phase (single sample);
5. RDF outside from the plant (single sample).

Solid material samples (RDF and MSW) were extracted at different stages of the process. The RDF and MSW sampling were carried out on the material falling down respectively from the last conveyor belt, before the storage, and from the belt conveying the material from the first grinders to the bio-boxes. For each sample (RDF and MSW) about 20 kg of material were taken. After the removal of materials that can damage the mill (metals, stones and glass), samples were shredded by a cutting mill with a 10 mm sieve. Both of the treated samples were mass reduced by a mechanical rotating tube divider before the last shredding phase, executed with the same cutting mill with a 1 mm sieve. Resulting sub-samples consisted in two 50 g samples (one of RDF and one of MSW) that were subsequently analyzed by an external laboratory.

Analysis methods complied with standards EPA 1613B/94 for solid samples and EN 1948/99 for gas samples.

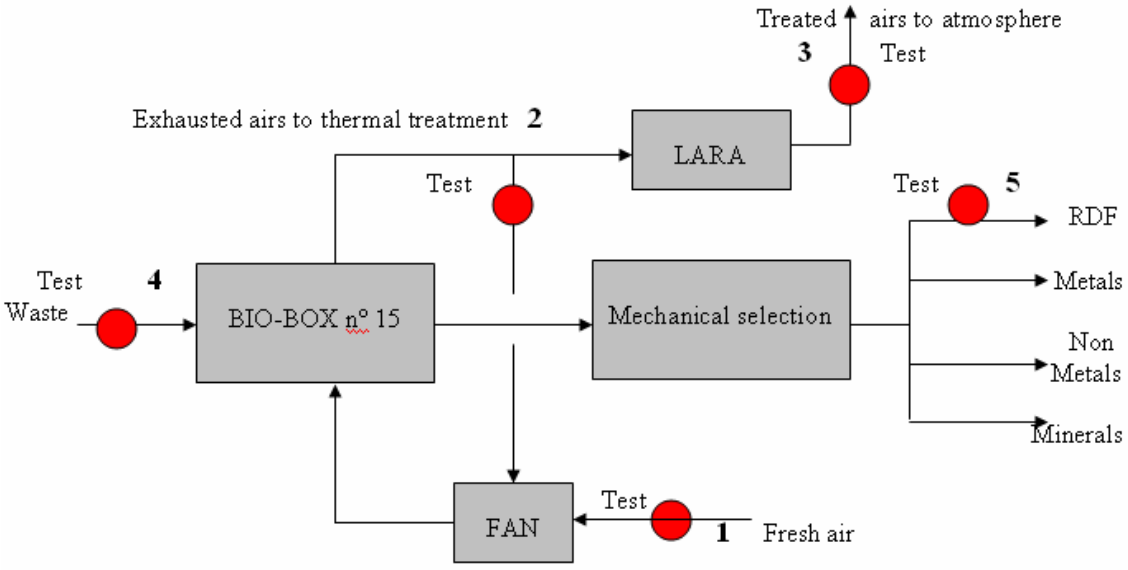


Figure 4: sampling points

In a first phase it was decided to avoid to perform tests on the metallic, non metallic and mineral fractions due to the connected sampling difficulty, and because it was supposed that, if present, PCDD/PCDF are mainly contained in the RDF fraction, for the affinity to organic compounds.

Results and Discussion

The process in bio-box n° 15 (temperature, air flow rates, pressure) on a weekly basis is shown in Figure 5.

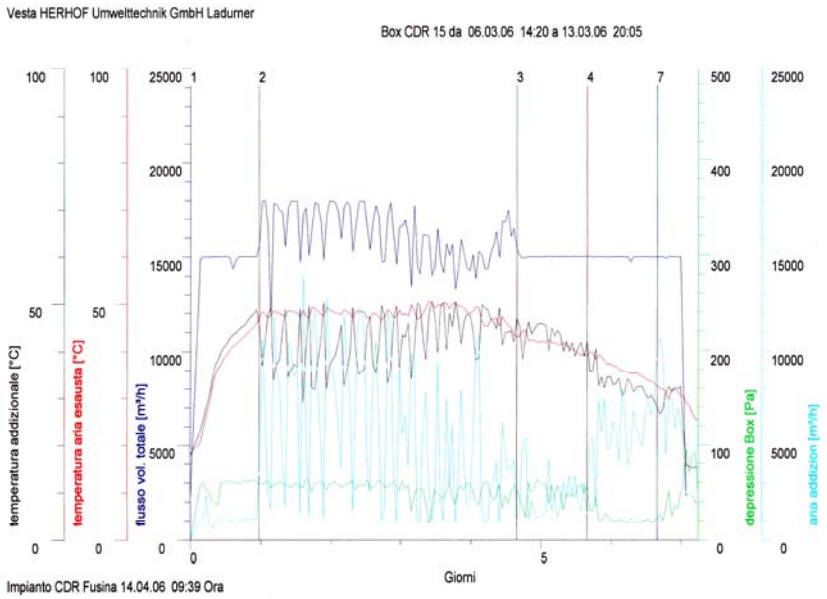


Figure 5: Bio-box graphics (air flow rate and temperature trends), courtesy of Ladurner SpA

From data interpretation, it is possible to evaluate the number of total normal cubic meters entering and exiting from the bio-box. Considering the input/output waste amount, it can be estimated the possible production of PCDD/PCDF during the process.

BIO-BOX n. 15				
Hours of running: 168	PCDD/PCDF concentration (TEQ)	Total material input/*output*	Total PCDD/PCDF (TEQ) input/*output*	Delta (TEQ)
Input waste	0,63 ng/kg	203 tons	127,9 µg	127,9 µg
Fresh air	0,0506 pg/ Nm^3	721292 Nm^3	0,04 µg	0,04 µg
RDF	*1,4 ng/kg*	*114 tons*	*159,6 µg*	*159,6 µg*
Exhausted air (without recycle)	*11,807 pg/Nm^3*	*706548 Nm^3*	*8,3 µg*	*8,3 µg*
Treated exhausted air (LARA)	*1,773 pg/ Nm^3*			
Total PCDD/PCDF produced				39,96 µg

Table 1: test results (mass balance)

Considering the results emerged from the different tests carried out (Table 1), it was not noticed a significative increasing of the PCDD/PCDF content due to the biological treatment process. As a first interpretation it can be hypothesized that the biological MSW treatment considered does not produce PCDD/PCDF.